Saskatchewan
Energy and Mines

Energy, Mines and
Resources Canada

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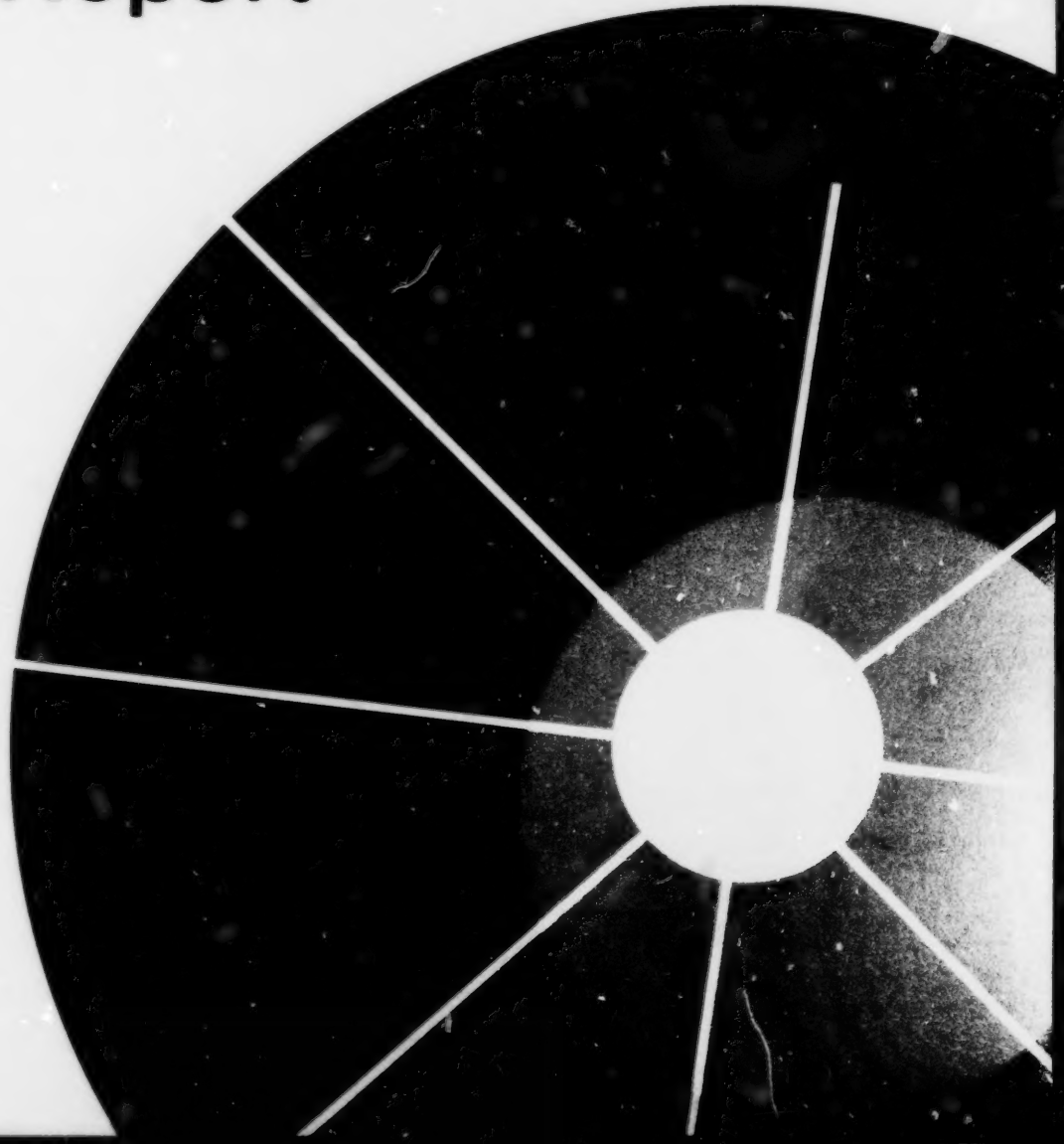
SASK 27

Canada - Saskatchewan Renewables — Conservation Demonstration Program

Final Report



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CANADA-SASKATCHEWAN CONSERVATION AND RENEWABLE ENERGY DEMONSTRATION AGREEMENT

On March 18, 1980, the governments of Canada and Saskatchewan entered into a Conservation and Renewable Energy Demonstration Agreement. The Agreement, which terminates March 31, 1984, funds the development and demonstration of a wide range of conservation and renewable energy technologies. The program is funded on an equal cost-shared basis by Canada and Saskatchewan, and is administered by Saskatchewan.

The objectives of CREDA are:

— To develop and demonstrate promising new technologies which exploit renewable energy resources, conserve energy, or make its use more efficient;

— To create employment in new or existing industries;

— To develop broad public awareness of the potential of renewable energy and energy conservation technologies.

This report outlines the results of a project funded by the Government of Saskatchewan as represented by Saskatchewan Energy and Mines, and the Government of Canada as represented by Energy, Mines and Resources Canada, under the terms of the Renewables-Conservation Demonstration Program, and contracted with the party identified herein.

However, neither the Government of Saskatchewan as represented by Saskatchewan Energy and Mines, nor the Government of Canada as represented by Energy, Mines and Resources Canada, accept liability for any errors, omissions, or inaccuracies that may; be included in or derived from this report, nor do they assume any liability with respect to the use of, or actions resulting from the use of, any information contained in this report.

Limestone Calcination Using Fire-Killed Timber

Final Technical Report
on a Renewables-Conservation Demonstration Program Project

Conducted By

Missi Island Mines Ltd.

And Supported By

Saskatchewan Energy and Mines
and
Energy Mines and Resources Canada

Project Leader: L.E.W. Hogg Jr.

Miscellaneous
Report FP-6

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Limestone Calcination Using Free-Killed Timber

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PINEHOUSE LAKE PROJECT

PROJECT SYNTHESIS

by

MISSI ISLAND MINES LTD.

March, 1982

MISSI ISLAND MINES

1. INTRODUCTION

The objective of the Report was to determine the technical and Economic feasibility of utilizing fire-killed timber as a replacement for fuel oil in the calcination of limestone. The examination included consideration of the Environmental Impacts of both wood harvesting and utilization.

The examinations were conducted by personnel from Missi Island Mines Ltd., The Saskatchewan Research Council, Ancon Research & Engineering, and Environmental Management Associates. The project was co-ordinated by Missi Island Mines Ltd.

The report was prepared with financial assistance from the Government of Canada and the Government of Saskatchewan under the Renewable Energy Program.

2. PROJECT METHODOLOGY

The initial examination of utilizing fire-killed timber as a fuel source indicated a very high potential of technical and economic success. The engineering principles involved were determined to be relatively simple. It was apparent that this basically simple technology of woodburning for the required temperatures and flame characteristics was in fact being used, but was not site specific for the Pinehouse Project. In order to insure that a system and technology was not in current use elsewhere in the world, an extensive literature search was conducted. The site specific requirements involving the nature and properties of the fire-killed timber were examined on site including discourse with the Department of Northern Saskatchewan, Forestry's Branch, for both the availability of supply and utilization. The selection of alternate burner and kiln types was then made. Theselections were made on the basis of the raw material available and the efficiencies of the burner systems. In the case of the kiln, selections were made on the basis of the raw material or stone characteristics and kiln efficiencies. Following the selection, Ancon Research & Engineering was then requested to prepare a cost analysis of the project incorporating the information. Environmental Management Associates were requested to review the utilization of fire-killed timber and prepare an Environmental Assessment.

- Missi Island Mines co-ordinated the study (Section A).
- The work conduction by The Saskatchewan Research Council is included in Section B.

- The work conducted by Ancon Research & Engineering is included in Section C.
- The work conducted by Environmental Management Associates is included in Section D.

3. EXAMINATION DIFFICULTIES

Considerable research and development has been conducted by firms and organizations, some of which have published results; however, the details were difficult to obtain or substantiate. This difficulty increased the time required to examine the various technologies. Many of the extended examinations were found to be unsuitable for the Pinehouse location.

4. CONCLUSIONS

Fire-killed timber can be successfully utilized to replace fuel oil. The ready availability of fire-killed timber in the Northern Saskatchewan area is unique to North America. The use of fire-killed timber for fuel is uncompetetive with exception of a very minor amount used for production of fence posts and local heating requirements. The terrain being essentially of low relief makes the fire-killed timber amenable to mechanized harvesting techniques. The harvesting can be conducted in both summer and winter depending upon the size, age and location of the burn. The most economic locations for harvesting are within a one hundred mile radius of the plant site. All fire-killed timber can be used regardless of species. The key factor for the harvesting of any fire-killed timber is when the burn is aged to the point where the moisture content averages approximately 20%. The moisture content reduces dramatically in the first two to three years after the burn, at which point the fire-killed timber is debarked and the extremely long cold winters essentially freeze-dry the timber. The short summer months with relatively light precipitation do not appreciably increase the moisture content of the timber. These conditions apply mainly to standing timber. Fallen timber retains appreciably higher moisture contents and in a mature burn is rotting beyond the third year. Fallen timber with rot and higher moisture content is unsuitable as a fuel. The harvesting procedures will have to be established in co-ordination with Forestry Departments as to the annual allowable cuts, the type of clearing and the time of clearing in the various burns.

4. CONCLUSIONS

Fire-killed timber can be successfully utilized to replace fuel oil. The ready availability of fire-killed timber in the Northern Saskatchewan area is unique to North America. The use of fire-killed timber for fuel is uncompetetive with exception of a very minor amount used for production of fence posts and local heating requirements. The terrain being essentially of low relief makes the fire-killed timber amenable to mechanized harvesting techniques. The harvesting can be conducted in both summer and winter depending upon the size, age and location of the burn. The most economic locations for harvesting are within a one hundred mile radius of the plant site. All fire-killed timber can be used regardless of species. The key factor for the harvesting of any fire-killed timber is when the burn is aged to the point where the moisture content averages approximately 20%. The moisture content reduces dramatically in the first two to three years after the burn, at which point the fire-killed timber is debarked and the extremely long cold winters essentially freeze-dry the timber. The short summer months with relatively light precipitation do not appreciably increase the moisture content of the timber. These conditions apply mainly to standing timber. Fallen timber retains appreciably higher moisture contents and in a mature burn is rotting beyond the third year. Fallen timber with rot and higher moisture content is unsuitable as a fuel. The harvesting procedures will have to be established in co-ordination with Forestry Departments as to the annual allowable cuts, the type of clearing and the time of clearing in the various burns.

Examination of the fires in the area indicates that they are unpredictable, but occur on a yearly basis. The quantity of fire-killed timber currently available and to be available on a 20 year basis is difficult to calculate, but is far in excess of the amount required as a fuel for calcining lime at the Pinehouse location.

The calculation of costs by the Research Council and Ancon Research & Engineering is approximately $7.00 per ton of lime utilizing fire-killed timber. The comparable costs utilizing fuel oil is $ 40 - 45
Other potential fuels, coal, natural gas, peat, LNG, and sawmill woodwaste were examined. The costs of fossil fuels and attendant transportation costs together iwth insecurity of supply were completely unacceptable. In the case of peat and sawmill woodwaste, peat could not be physically handled or acquired, nor is it evident that the required temperatures and flame characteristics could be achieved; sawmill woodwaste is an insecure and irregular source of supply with difficult handling problems and could not be considered a uniform fuel as the moisture content varied dramatically and would have to be dried prior to utilization. Transportation costs from existing sawmills, even on the basis of no cost sources, is uncompetetive with fire-killed timber.

The Environmental review of utilitizing fire-killed timber did not identify any negative impacts and that an effective management plan could mitigate any potentially negative impacts. A potentially positive socio-economic impact exists with the harvesting operation by way of providing temporary and permanent employment in the region.

The economic review of the impact of utilizing fire-killed timber for fuel on the entire project has demonstrated a dramatic operating cost saving without increasing the capital requirements.

5. RECOMMENDATIONS

The calcining characteristics of the limestone must be determined before final selection of the kiln type can be made. Once the kiln type has been selected, the appropriate burner system can be incorporated. Selection of the burner system will dictate the final wood requirements and final handling and gathering systems.

Missi Island Mines Ltd. should proceed with the project utilizing fire-killed timber as a fuel source. The company should further carryout the recommendations of The Saskatchewan Research Council, Ancon Research & Engineering Ltd., and Environmental Management Associates. The work should commence in 1982.

LIMESTONE CALCINATION UTILIZING FIRE-KILLED AND OTHER FOREST BIOMASS IN A DIRECT FIRED FEED BURNER

by

D.H. Filson

March, 1982

SRC Publication No. E-835-1-C-82

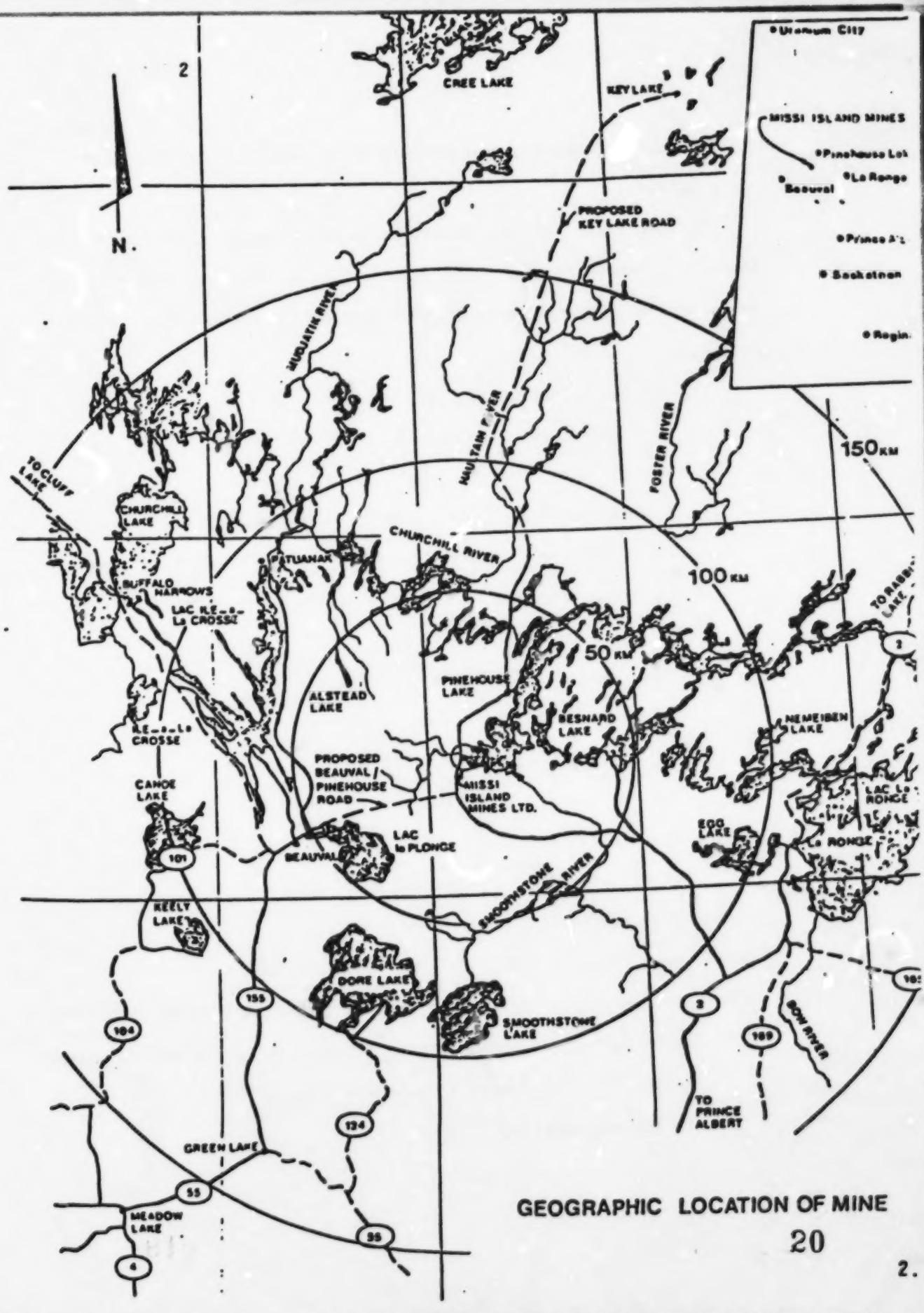
Limestone Calcination Utilizing Fire-killed Trees and Other Forest Biomass in a Direct Fired Feed Burner

1. Introduction

Missi Island Mines has located a large limestone deposit 35 km south of the village of Pinehouse Lake. The location of the deposit is given on the map, page 2 taken from a report by D.W. Bradley (1). The development of the deposit would contribute to the economy of the area providing employment for some and a convenient lime source for Saskatchewan uranium producers.

Considerable information on the lime deposit was obtained in 1978 and 1979 by Missi with the assistance of Kilborn Engineering. Their two reports (2) (3) discuss items such as size and quality of the deposit, mining and processing methods, manpower, capital and operating costs, marketing and transportation.

The purpose of this part of the total project is to study the feasibility of utilizing local wood fuel for calcining limestone.



GEOGRAPHIC LOCATION OF MINE

20

2.

2. Information Obtained on Commercial Wood Combustion Systems and Lime Kilns

To date there has been no visits by Saskatchewan Research Council staff to sites where wood burning combustion systems and lime kilns are in operation. Several contacts were made to equipment manufacturers by telephone.

1) Energex suspension burner. June 81.

Russ Andrusack, Richmond, B.C. 604-273-3141

George Powis, Brampton, Ont. 416-451-4990

Information - Wood fuel, <1/8", < 15% moisture will achieve 2300°F with 90% excess air, 2700°F with 40% excess air. De-bark to remove dirt and grit from skidding logs. Equipment operating at Sioux Lookout and Atikokan.

2) Experimental kiln. June 81.

CANMET, Ottawa. Friedrich, Lee, and Brown

613-996-4570 extensions 185, 181, 191

Information - Some tests were made with a 3' x 14' tunnel kiln. Results confidential.

It is difficult to pulverize wood.

3) Coen suspension burner. June 81

Doug Fromson, Vancouver, B.C. 604-254-0461

Information - There is no problem technically in burning lime with wood fuel. Wood must be fairly dry. Chips are pulverized. Pulverizing equipment is sold with the burner.

Brochures received.

4) Fluo-solids lime kiln. July 81

Ken Smith and Tom Varghese of Dorr-Oliver

174 West St. South, Orilla, Ont. L3V 6L4

phone: 416-363-8781 or 705-325-6181

Their fluidized bed lime kiln was discussed. A brochure was received which was later given to Mr. Hogg.

On 27 January, 1982, Mr. Hogg visited the Council. We phoned Tom Varghese and requested a visit to the site of an operating kiln. Mr. Varghese eventually arranged a trip. Filson (SRC) and Varghese would meet in Toronto February 21 and fly to Tampa, Florida. On February 22 we would drive to Ocala to see their lime kiln and return to Toronto the next day and tour Darr-Oliver facilities.

On checking with Mr. Hogg I was advised to postpone this trip. He said there are two fluidized bed lime kilns in western Canada, one in Edmonton which is giving trouble and one operated by Crest Brooke Pulp which is working quite well. Crest Brooke Pulp is at Cranbrooke, B.C. 604-426-6241.

I phoned Tom Varghese to have the trip postponed. Mr. Varghese was away so I spoke to his supervisor, Ken Smith. I enquired about the Edmonton kiln. Mr. Smith told me that the Edmonton kiln was not built by Dorr-Oliver but was "a poor copy". Mr. Smith has seen the kiln and was asked to improve it. However the Edmonton firm would not agree to his consulting fee. The Cranbrooke kiln was built by Dorr Oliver. It burns wet $CaCO_3$

filter cake containing small quantities of sodium which appears to aid the operation.

Mr. Smith said there were 21 other Dorr-Oliver fluidized bed calciners operating in American with capacities up to 260 tpd. Four of these are in Massachusetts, one is fuelled by coal. He said that wood fuel could be used.

Dorr-Oliver have test facilities at Stamford, Connecticut. A minimum limestone sample of 500 lbs. is required for a fluidized bed lime burning test.

5) Lamb-Cargate multiple chamber combustor.
New Westminster, B.C. 604-521-8821
Information -This burner is described in the Levelton Publication (7). Mr. Lamb said that ash was now removed mechanically. One of their burners is operating at Port Alberni calcining lime in a rotary kiln. Output temperatures of 2250°F have been obtained using wood with 40% moisture.

Mr. Hogg suggested that I request a visit to Port Alberni. On calling Mr. Lamb I was informed that the kiln would not be in operation again until March, 1982. Mr. Hogg advised me to write a report without waiting for a visit.

3. Program for the Design and Construction of a Lime Calcination Facility at Pinehouse

To be developed as part of Phase II of the project.

4. Lime Calcination

The dissociation temperature of calcite ($CaCO_3$) given by Boynton (4) is 898°C (1648°F) at a pressure of one atmosphere. Heat required for the endothermic reaction $CaCO_3 \rightarrow CaO + CO_2$, calculated from heat of formation data (5) is 4375 kcal per metric ton of limestone. Thus the theoretical heat required to produce one ton of lime from limestone (specific heat = 0.255) at 0°C = $\frac{100}{56}$ (255 x 898 + 4375) = 418,000 $\frac{kcal}{mt}$ or 1.5 x 10^6 $\frac{btu}{ton}$ more heat is required to maintain the dissociation temperatura until all CO_2 is expelled. Boynton (4) states that the minimum heat required to make a ton of lime from pure $CaCO_3$ is 2.77 million btu/ton or 770 kcal/kg.

Generally a high burning temperature and long calcining period yields a hard burned, dense, unreactive lime. Burning at a lower temperature or shorter burning time yields the desirable soft burned, reactive, low density lime (4). Tests have shown that "There is an optimum calcination temperature and rate of heating for every limestone that can only be determined by experimentation" (4).

It was realized at the beginning that conventional fuels for limestone calcination would be very expensive at the Pinehouse site. The alternative is the use of local wood fuel. Can a wood burner achieve continuous kiln temperatures of 1100°C (2012°F) needed for lime calcination? The answer is a qualified yes. The wood must be fairly dry and be burned with a minimum of excess air.

Bone dry wood from many tree species have a calorific value of 8500 btu/lb (6). It takes about 1200 btu to vaporize a pound of water and

raise it to flue gas temperature. Thus wood having 10% moisture (wet) would have a net heating value = 8500 (0.9) - 0.1 x 1200 = 7530 btu/lb and wood having 50% moisture would have a net heating value = 8500 (0.5) - 0.5 x 1200 = 3650 btu/lb. Excess air absorbs some of the heat produced thus lowering the flue gas temperatures.

Four general types of equipment were considered for wood fuel utilization, suspension burners, gasifiers, fluidized bed and multiple chamber combustors. Fluidized bed combustors were ruled out because flue gases were released at relatively low temperatures. Wood gasification was considered to be an unnecessary step and was also ruled out although one company "Omni Fuel" claims to have developed a successful commercial gasifier. The choice then was between a suspension burner and a multiple chamber burner.

B.H. Levelton and Associates (7) have evaluated wood burning equipment. Compare data from this publication on a typical suspension and multiple chamber burner.

Type	Suspension	Multiple Chamber
Make	Energex	Lamb Cargate
Max wood size	1/8"	3"
Wood moisture	<15%	35%
Excess air	60-130%	15%
Temperature	2000°F	2600°F

Company brochures were obtained from Coen who for somtime have manufactured and sold their suspension burner, and from Lamb-Cargate who have some recent commerical installations. A brochure from Coen and a drawing from the Lamb-Cargate literature are attached.

Data for the Energex suspension burner are shown in the comparison above since more data was given for it in the reference (7) than for the Coen burner. The two burners are similar however. From the data presented the Lamb-Cargate multiple combustor is the number one choice. Feed preparation costs would be much less for the Lamb-Cargate than for a suspension burner. Assuming the data are correct, fuel from fire-killed trees need not be dried. Any sand or dirt on the fuel logs would drop out in the primary chamber of the Lamb-Cargate and be removed with the ash instead of reporting with product lime. Higher output temperatures are shown for the Lamb-Cargate as little excess air is needed. I would like to see one in operation, however, before making a final reommendation.

Let us turn now to the question of kilns. A good treatment of this topic is given by Boynton (4). Information on kilns used in Europe is given in the May 81 Journal of Industrial Minerals (8).

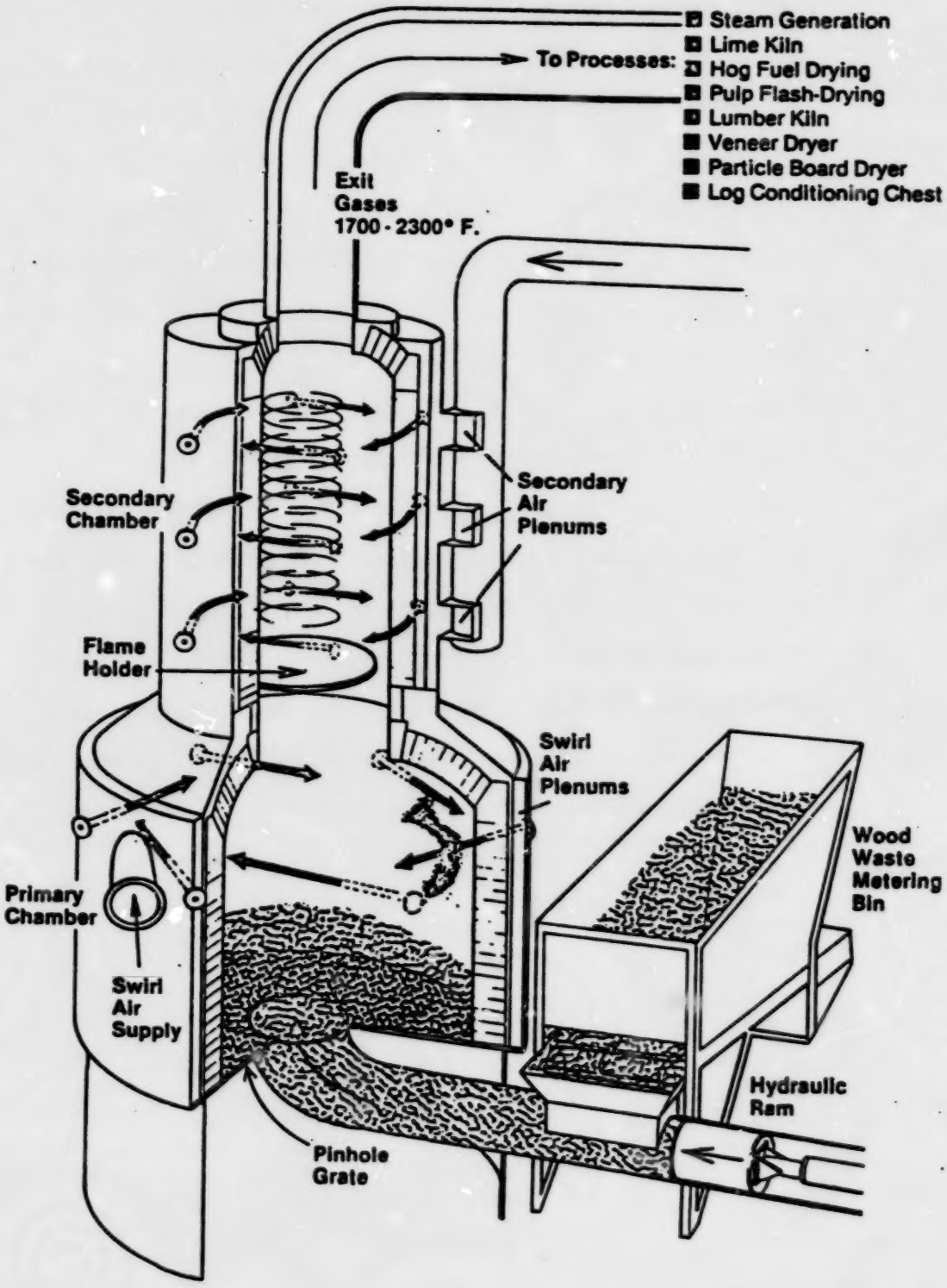
Types of Lime Kilns are:

1) Vertical or Shaft Kilns. These are popular in Europe. There are different types of shaft kilns. All types have shown good fuel economy. Unfortunately, their use is restricted to stone in the size range 5 - 12 cm. The double inclined shaft kiln will handle stone down to 1.9 cm and for this reason could be useful at Pinehouse. Gas fuel is ideal but coal, oil and wood may also be used.
2) Rotary Kilns. These are a high capacity kilns which operate well on stone of 0.5 to 5 cm in size. These have poor fuel

economy unless equipped with expensive preheaters. Rotary kilns can successfully handle a wide range of feed site but tend to produce a high portion of fines. Pulverized coal is considered the best fuel but gas, oil and wood may also be used.

3) Calcimatic Kiln. "It features a large diameter, circular refractory hearth that can be operated at various speeds" (4). Boynton states that fuels are limited to gas and oil and that fuel economy has been a "disappointment".

4) Fluo-Solids Kiln. This is a fluidized bed kiln comprising from three to five chambers which achieve preheating, calcining and lime cooling. This type of kiln appears to be a good choice for Pinehouse limestone which decrepitates easily on calcining and has a high portion of fines in the feed. It is also reasonable to use wood fuel with this kiln because it operates at lower temperatures than other lime kilns. One should however see a successful commerical unit in operation and have favourable data from a fluo-solids test facility before making a final recommedations.


Steam Generation
Lime Kiln
To Processes:
Hog Fuel Drying
Pulp Flash-Drying
Lumber Kiln
Veneer Dryer
Particle Board Dryer
Log Conditioning Chest
Exit
Gases
1700 - 2300° F.
Secondary
Chamber
Secondary
Air
Plenums
Flame
Holder
Swirl
Air
Plenums
Wood
Waste
Metering
Bin
Primary
Chamber
Swirl
Air
Supply
Hydraulic
Ram
Pinhole
Grate

LAMB WET-CELL BURNER

CUSTOMER LIST

No. of Units	Size BTU/Hour	Continuous Ash Discharge	Use	Customer Location
1	20×10^6	No	(2) Lumber Kilns	Plateau Sawmills Engen, B.C.
1	25×10^6	No	Pulp Flash Dryer	Winstone Samsung Karioi, New Zealand
1	60×10^6	Yes	Lime Kiln	MacMillan Bloedel Ltd. Port Alberni, B.C.
2	45×10^6	Yes	Rotary Dryer -- Flakeboard	Northwood Chatham, New Brunswick
1	10×10^6	Yes	Boiler	Gander Hospital Gander, Newfoundland
2	45×10^6	Yes	Rotary Dryer -- Flakeboard	Northwood Bemidji, Minnesota
1	45×10^6	Yes	(4) Lumber Kilns and Building Heat	Plateau Sawmills Engen, B.C.
1	25×10^6	Yes	Barite Concentrate Drying	Milchem Inc. Caddo Gap, Arkansas
1	25×10^6	Yes	(2) Lumber Kilns	Weyerhaeuser DeQueen, Arkansas
2	60×10^6	Yes	(2) Thermal Oil Heaters -- Flakeboard	Weyerhaeuser Grayling, Michigan
1	25×10^6	Yes	High Speed Lumber Kilns	Australian Paper Mfgrs. Tumut, Australia
1	60×10^6	Yes	(3) Lumber Kilns	Hammermill Paper Co. Moundville, Alabama
2	25×10^6	Yes	(2) Lumber Kilns	Federal Paperboard Liiesville, N. Carolina

FHL/ew
July/81

5. Economics of Using Wood Fuel for Lime Manufacture

Only fuel required for limestone calcination will be considered here.

Boynton (4) states that 5,000,000 btu are required to calcine one ton of lime in a fluidized bed kiln. Plan for 15% increase to allow for losses and inconsistent fuel quality, e.g., wet weather. Assume 20% moisture in fire killed trees.

Net heating value = 8300 (0.8) - 0.2 x 1200 = 6400 btu/lb.

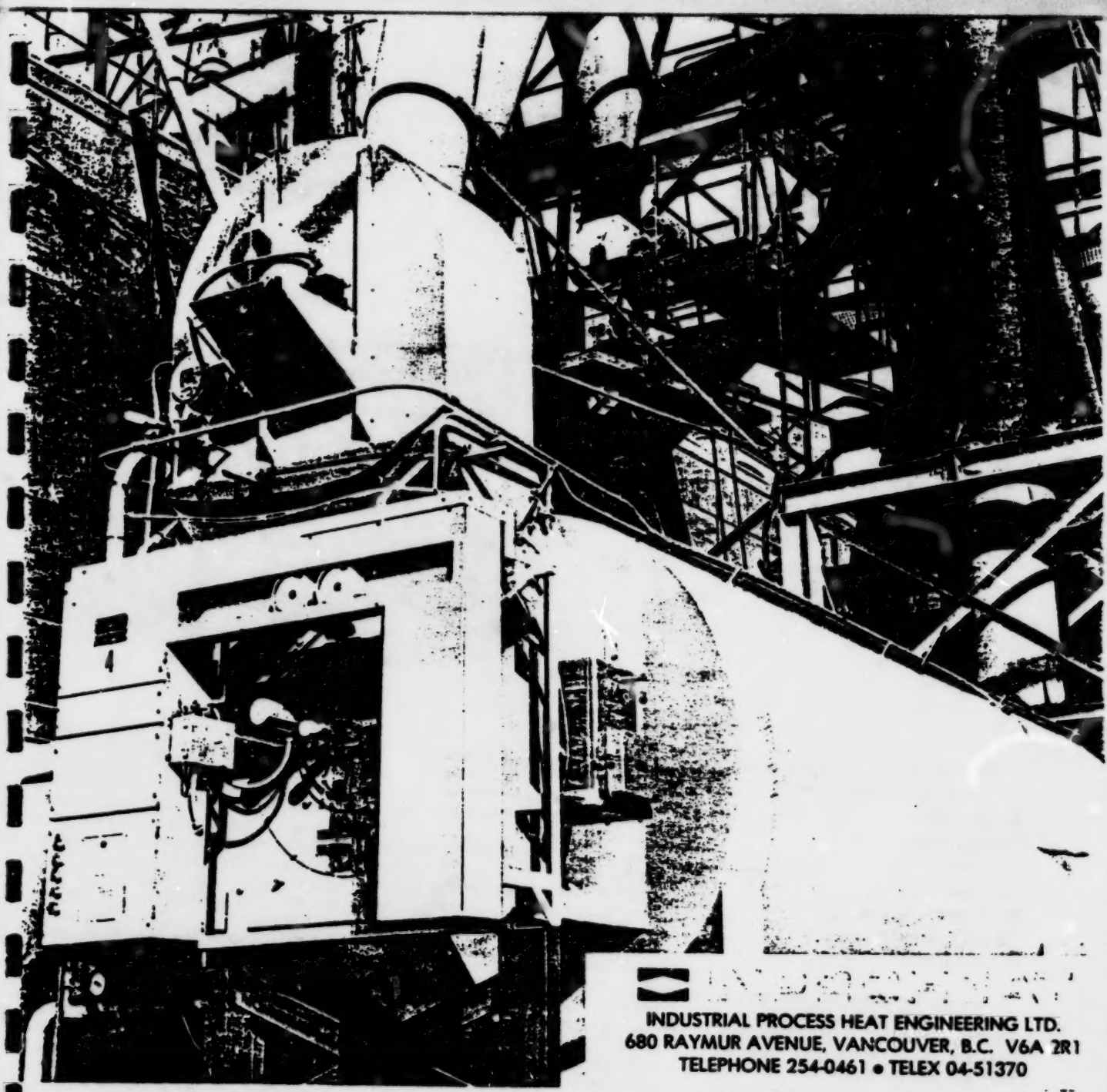
Wood fuel required per ton of lime

$$= \frac{1.15 \times 5{,}000{,}000}{6400} = 900 \text{ lbs.} = \frac{900}{4000} = 0.225 \text{ cords}$$

$$\sim 0.225 \times 245 = 55 \text{ ft}^3 \text{ of chips (9)}$$

The actual cost of fuel at Pinehouse is not known to the author. Relatively wood fuel at $30.00 per cord or $6.75 per ton of lime would be equivalent to fuel oil at $.05¢ per litre or gas at $1.35/MCF.

The lime production rate planned for Pinehouse is 60,000 tpy. For calcination this would require 60,000 x 0.225 = 13,500 cords of wood annually. The annual allowable cut in the Pinehouse area including townships 70 to 80, ranges 3 to 10 is 133,128 cords of softwood and 34,837 cords of hardwood according to a memorandum from the Provincial Forestry Branch (10). Thus forest biomass in the area is adequate.

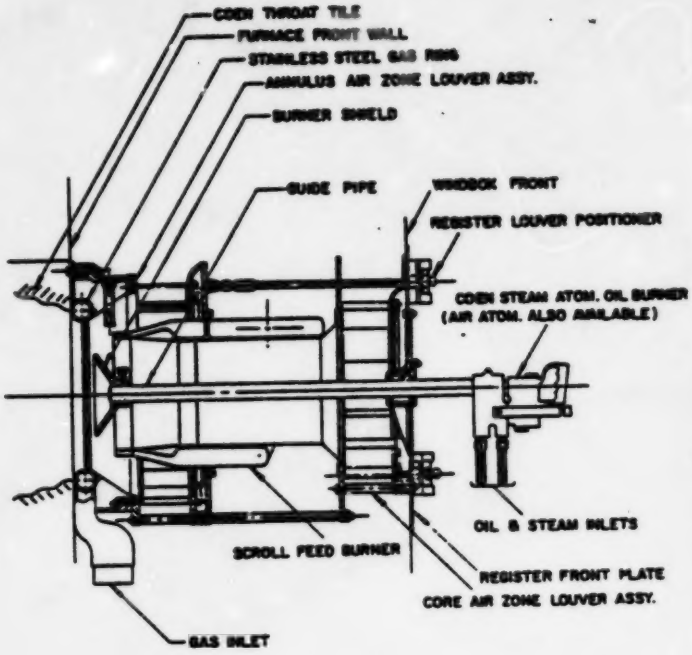


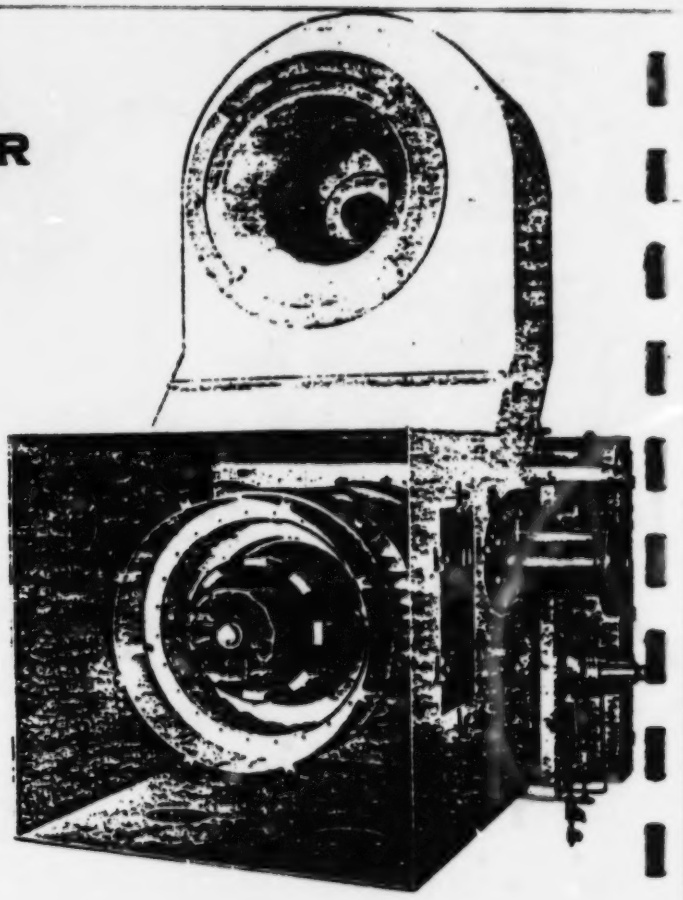
INDUSTRIAL PROCESS HEAT ENGINEERING LTD.
680 RAYMUR AVENUE, VANCOUVER, B.C. V6A 2R1
TELEPHONE 254-0461 • TELEX 04-51370

WOOD WASTE BURNING SYSTEMS

COEN COMPANY
Combustion Engineers and Manufacturers
Burlingame, California

COEN DAZ *(Dual Air Zone)* SCROLL FEED BURNER





...for complete combustion of air conveyed dry solid fines such as:

Sander dust.
Ground wood waste.
Bagasse fines.
Rice hull fines.
Sunflower seed fines.
Or other finely ground organic fibers.

Firing with air conveyed solid fines or with low BTU gases always presents combustion difficulties, and these problems are greatly accentuated when the materials are to be burned in a water wall packaged boiler in which there is little or no hot refractory to sustain combustion. Coen has solved this problem with the introduction of the exclusive DAZ Scroll Feed Burner.

The well known Coen DAZ register burner, modified by the addition of an interzone scroll feed, has proved in operation to be a remarkably effective method of burning these problem fuels. The DAZ, which stands for "Dual Air Zone", is actually two registers in one, with concentric louvers which in effect divide the air stream into two counterrotating concentric streams. As these air streams scrub against each other, they provide turbulent mixing action without the net rotative effect found in single louver registers. The result is a compact flame pattern which is very advantageous in many boiler applications.

However, it is the unique method of introduction of the air conveyed fuel that is primarily responsible for the highly successful operation of the Coen DAZ Scroll Feed Burner. Realizing that the area of maximum turbulence and mixing is the interface between the two air streams, Coen engineers have developed a method of introducing the solid fines or low BTU gases directly into this area. The feed scroll on the burner is located and designed so as to feed the fuel uniformly into an annulus between the two air streams. The fuel, entering at low velocity, is scrubbed and thoroughly mixed with air in this zone. Combustion originates well back in the throat of the burner, thus maintaining a hot refractory throat, which in turn radiates back into the flame body and provides additional flame stabilization.

BURN WASTE FUELS WITHOUT AIR POLLUTION

A common approach to utilization of sander dust or similar air conveyed solids is to introduce these fuels into the furnace through a pipe. With this method, smoke is generally produced even though adequate excess air is provided, because it is difficult for combustion air to penetrate the stream of solid fines. Thus, combustion starts at the outside of the stream and the heat from this combustion causes cracking of the fuel in the interior of the stream where combustion air is deficient, with smoke as a result. In contrast, the Coen DAZ Scroll Feed Burner introduces the fuel in such a way that it can be completely mixed with all of its combustion air before "chilling", to insure complete, smoke-free combustion.

With the combination of the exclusive DAZ Register and the unique annular feed, stable, complete combustion is maintained with these difficult fuels and air conveyed solids (with particle size of 1/64" to 1/16" depending on applications) are actually burned in suspension. This flame stability and completeness of combustion is even possible when the Scroll Feed Burner is used on a full water wall packaged boiler. No other burner is capable of matching this performance.

SIZE REDUCTION EQUIPMENT

Properly applied size reduction and screening equipment is all important for proper burner operation. *(See back page.)*

WOOD WASTE FIRED AIR HEATERS

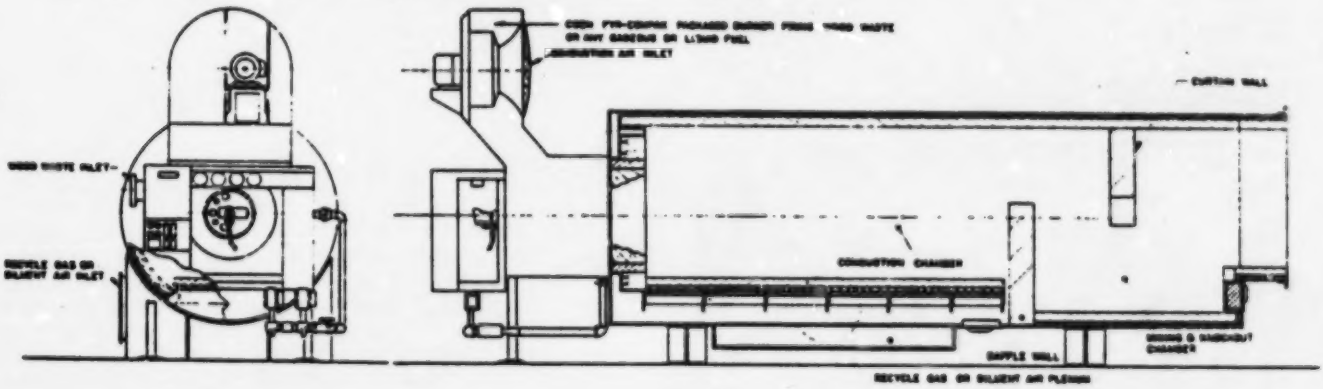
With both price and availability of gas or oil fuels causing major problems to plant operations, the utilization of wood waste as an energy source has become more of a necessity than an attractive possibility in recent years. Most plants have found that wood waste is a good source of heat, and are utilizing this heat in boilers or air heaters as they dispose of their wood waste. In the wood industry many plants require large quantities of heat for various drying functions. The Coen wood waste fired air heater provides this heat in quantities and temperatures suitable for specific plant requirements.

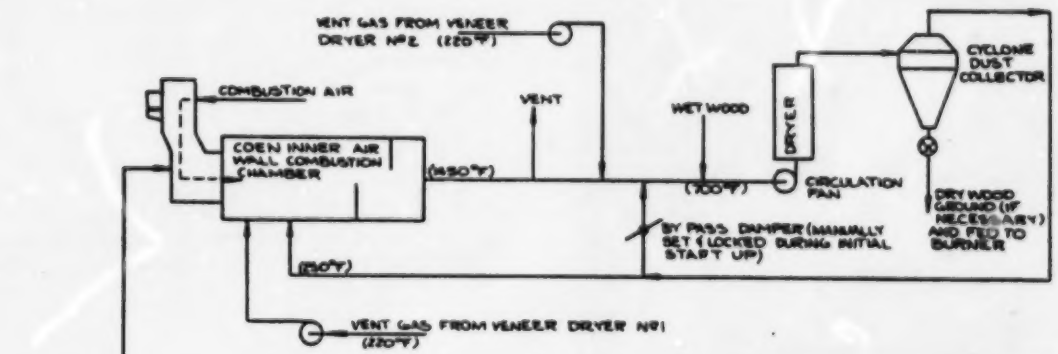
While a number of Coen air heater designs are available, the normal selection is the "Inner Air Wall" air heater illustrated, fired with a Coen Scroll Feed Burner attached. The chamber is designed so as to provide combustion temperatures and retention time adequate to insure complete burnout of the wood waste particles within the chamber. The baffle and curtain walls and the mixing and knockout chamber provide vigorous mixing of combustion products and recycle gas (or diluting air) and results in even temperature profile and eliminates localized heat effect to the products or dryer. The air heater can be designed so that it is large enough to permit a low velocity through the knockout chamber which will drop out oversize, unburned particles. This generally is less economical than a smaller heater with complete screening of the fuel and/or finer grinding in the case of the higher heat release furnace selections (lesser retention time).

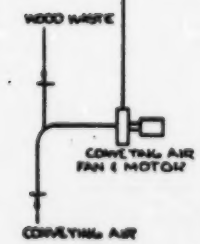
The inner air wall design permits these heaters to operate with walls below the ash fusion temperature and thus slagging and unnecessary refractory failure is eliminated. The unique gas recirculation system, which keeps a low oxygen level in the dryer, virtually eliminates dryer fire hazard.

The same inner air wall air heater can also be used to incinerate the hydrocarbon vapors present in the exhausts of veneer dryers, rotary dryers, dry kilns, etc. Full details of the Inner Air Wall air heater are available in Coen Bulletin AH-74.

(Inner Air Wall air heater covered by U.S. Patent No. 3,752,405).





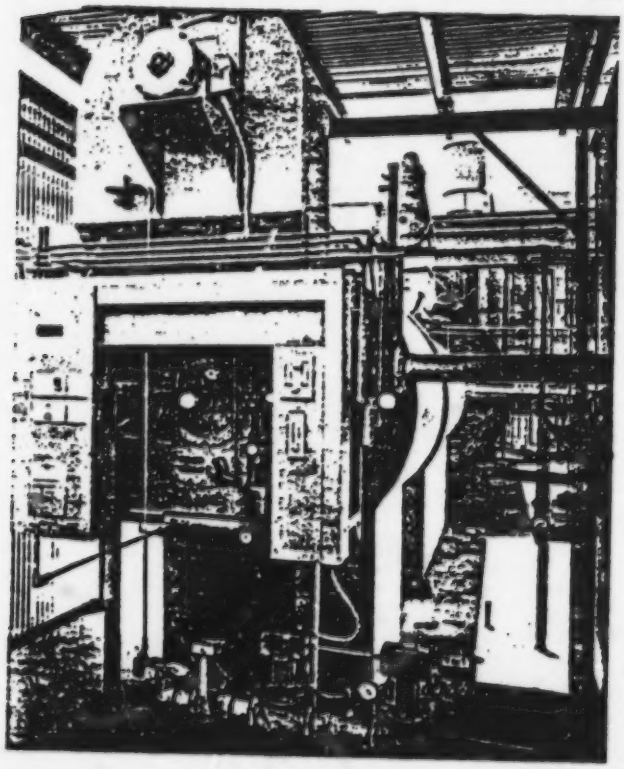


WOOD WASTE FIRED INCINERATOR

In past years it was common to dispose of wood waste in teepee or similar type incinerators. Since the advent of strict air pollution laws, the use of these incinerators has about been curtailed. Most plants have found that wood waste is a good source of heat but some plants are unable to utilize this heat in boilers or air heaters, yet must dispose of large quantities of wood waste. For these plants, Coen offers a scroll feed fired incinerator. This incinerator consists of a Coen Scroll Feed Burner attached to a refractory lined combustion chamber. Coen "Inner Air Wall" combustion chamber described above can dispose of wood waste by simply burning the same and discharging combustion products to atmosphere. The same unit can also be designed to incinerate the hydrocarbon vapors present in the exhausts of veneer dryers, rotary dryers, dry kilns, etc.

As all wood contains ash, in varying quantities, it may be necessary to install ash removal equipment to meet some particulate codes. The illustration shows a typical Coen wood waste incinerator system designed to incinerate hydrocarbon vapors from two steam coil veneer dryers and at the same time dry the required wood fuel for the incinerator.

WOOD WASTE FIRED

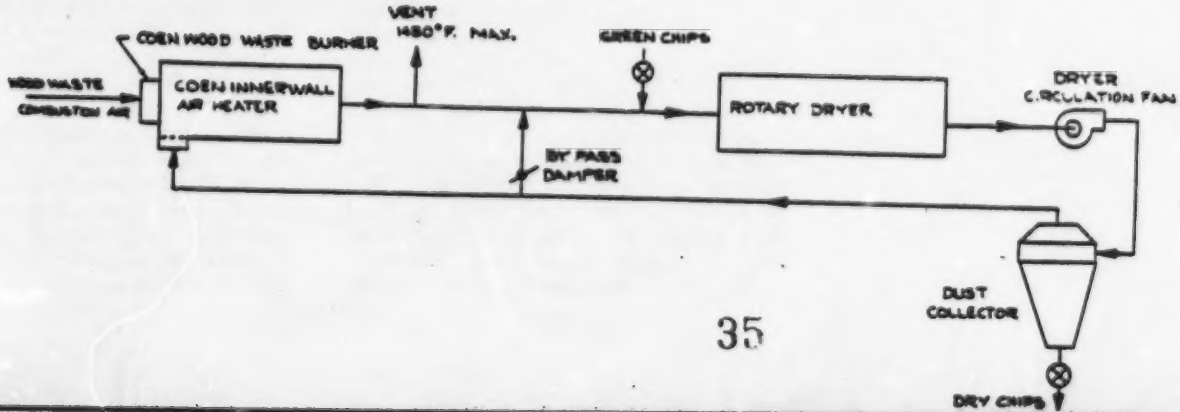


Cover photo and the photo on the left shows the installation of two Coen "Inner Air Wall" air heaters at the Timber Products Co. in Medford, Oregon. Each heater, firing sander dust, natural gas or LPG to 12 MM BTU/HR for a wood chip rotary dryer, is designed for 100% dryer exhaust gas recirculation for incineration of same. The installation is the first and the only installation as of July, 1974 complying with the current State of Oregon air pollution regulations. The system flow schematic is same as the one shown at the bottom of this page.

ROTARY DRYERS

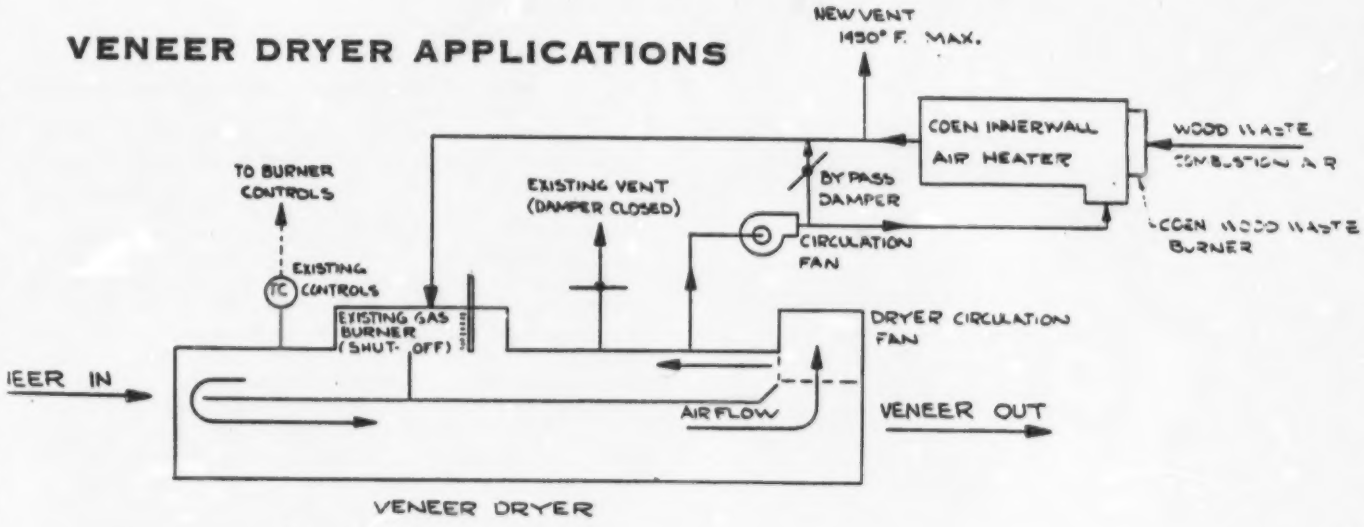
Rotary dryers are used for drying wood chips for particle board, briquetting plants and many other drying applications. Coen wood waste fired air heaters may be furnished as part of a field assembled package with a new dryer, or may be applied to existing rotary dryers. In either case, Coen is capable of supplying an air heater precisely designed to meet plant requirements. In addition to wood waste firing capability, these air heaters are designed to fire a wide variety of fuels, including gas and fuel oils. They are also capable of maintaining close control of dryer discharge air temperatures over a wide range of heat inputs. Automatic controls are normally furnished to control firing rate so that heat input is varied according to load and wetness of the feed, while maintaining air temperature at the discharge of the dryer.

When firing directly into a rotary dryer it is essential that combustion be completed within the air heater itself. Coen wood waste fired air heaters are designed so that burn out is complete provided wood waste particle size and moisture content is within Coen requirements. Screening of feed is normally required. See back page for suggestions for a successful wood waste firing system.



AIR HEATER APPLICATIONS

VENEER DRYER APPLICATIONS



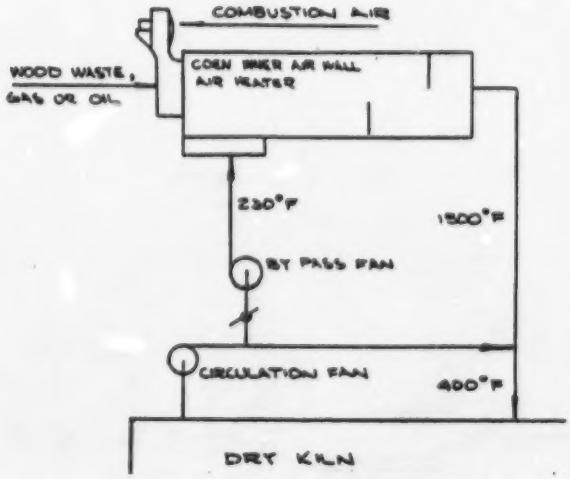
Coen wood waste fired air heaters can provide three major advantages for veneer dryer owners. First of all, the wood waste burner provides disposal of wood waste, a problem for many plants. Secondly, fuel costs are substantially reduced; with rapidly escalating purchased fuel costs, this can mean savings of many thousands of dollars a year for each veneer dryer. Finally, the Coen wood waste air heater system can be installed so as to act as a fume incinerator for blue haze. Blue haze is familiar to all veneer dryer operators, and is caused by volatiles in the wood being driven off by the heat of the drying process. In the past, blue haze was tolerated as a nuisance, but current air pollution regulations no longer permit this blue haze to be discharged into the atmosphere.

In the drawing above, it is shown how a veneer dryer may be modernized by a Coen wood waste burning system that includes incineration of blue haze. Note that fumes from the veneer dryer are passed through the Coen "Inner Air Wall" air heater where their direct exposure to and contact with flame burns out the blue haze.

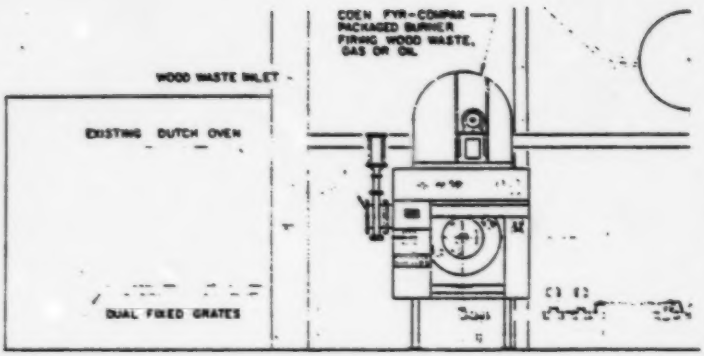
Coen wood waste firing air heaters are applicable to conventional one or two pass veneer dryers, and may be also applied to replace steam coil dryers.

DRY KILN APPLICATION

Dry kilns are usually used for drying of dimensional lumber. As such, they are low temperature, and are often heated with steam coils. However heated, these kilns still require heat and heat is becoming increasingly expensive. In many plants the dry kiln is the logical place to utilize the heat generated in the incineration of wood waste. Should your plant have both a source of wood waste and a dry kiln, you may be able to effect a substantial reduction in your fuel bill as well as effectively disposing of your wood waste.



FIELD ERECTED BOILERS

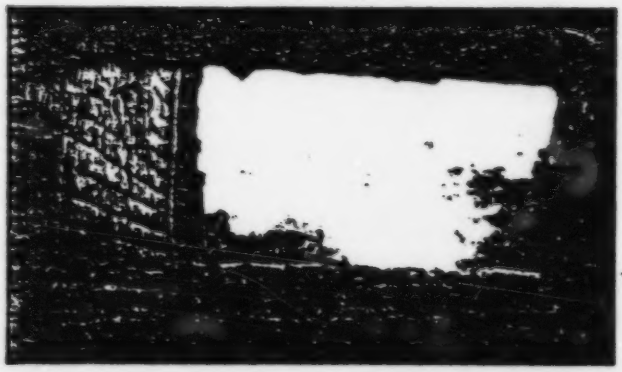


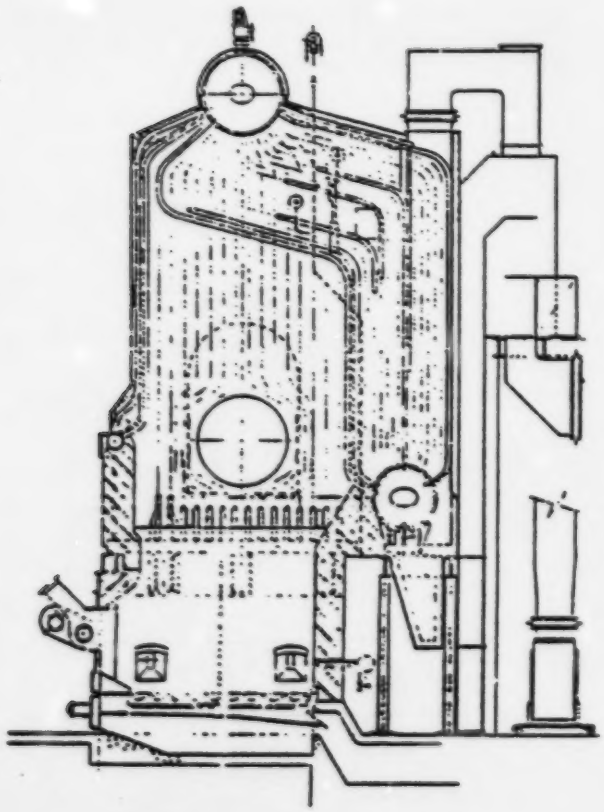
Dutch Oven Fired Boilers

As most wood processing plants require steam, and thus have a boiler plant, the generation of steam from wood waste is not only logical, it has been an accepted method for many years. Most field erected boilers that burn wood waste use dutch ovens or stokers. In the past, sander dust, hog fuel, and all wood waste was just dumped into the furnace. This caused smoke which is no longer tolerated, nor with present fuel costs can the inefficiencies of most such furnaces any longer be tolerated. This situation has been solved at many plants by the installation of a Coen Scroll Feed Burner to existing boilers.

An outstanding example is the installation illustrated at the left, one of two 31,000 PPH 4 drum Stirling boilers installed at U.S. Plywood in Lebanon, Oregon. This plant had been dumping sander dust into the furnaces of these boilers through a pipe. This method of introducing sander dust did not permit complete combustion and the result was heavy smoke. The Oregon pollution board threatened to shut this plant down unless this situation was corrected. Two Coen Scroll Feed Burners were installed, one on each boiler, and the results were dramatic. Not only did the sander dust burn cleanly through the Coen burners, but by burning in suspension beyond the dutch ovens acted as an after burner to burn out any smoke coming off the oven.

In the photo (below), taken through a "peep" over a dutch oven grate that was temporarily empty (ashes being raked), the flame of the Coen Scroll Feed Burner, firing with sander dust, can clearly be seen. This flame is so clean and complete that it appears to have the form of a gas flame and the color of an oil flame.





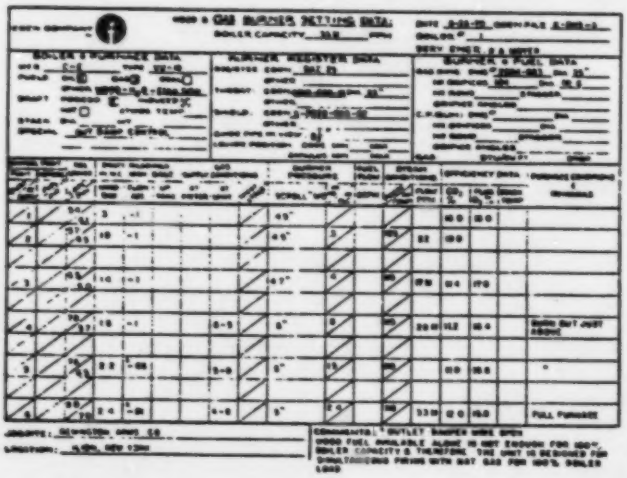
Stoker Fired Boilers

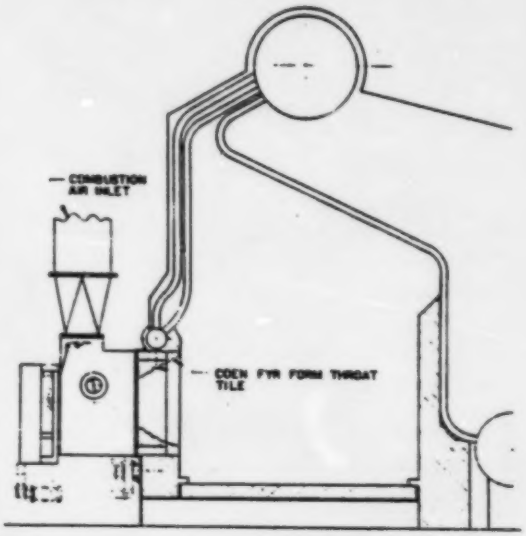
While the installation above is firing into a boiler that is normally fired with a dutch oven, the drawing at left shows a Coen wood waste burner applied to a stoker fired boiler. As boilers vary widely in design, capacity, firing methods, etc., it is always necessary to carefully engineer each application. On new field erected boilers Coen works with the boiler manufacturer to locate the burner and provide a burner opening. On existing field erected boilers, Coen will provide engineering details on how the burner is to be installed. In all cases the burner application is engineered so as to provide complete burnout of the wood waste in the furnace, while utilizing the furnace so as to provide good radiant transfer into the furnace tubes.

BOILER APPLICATIONS

MULTIPLE WASTE FUEL BURNING

The conversion illustrated at right solved a plant's waste disposal problem while substantially reducing fuel costs. This plant manufacturers firearms and in addition to sander dust from walnut stock finishing, the plant had considerable quantities of waste cutting oil in a water emulsion to dispose of. The existing boilers were 35,000 PPH CE type VU-10, and were normally gas and oil fired. They were converted to Coen Scroll Feed Burners with capability for wood waste, gas and oil firing. In addition, Coen provided means to fire the 95% water oil emulsion simultaneously beneath the flame of the other fuels. The result is an installation that not only disposes of these waste products efficiently and without pollution, but that also substantially reduces the annual fuel bill.



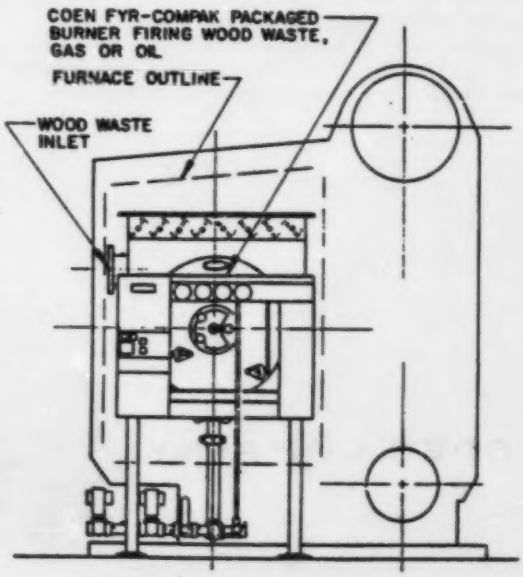


For start-up of Coen Scroll Feed Burner a factory employed and trained service engineer can be made available to set-up burner and controls to optimum performance and make a record as shown on left.

PACKAGED BOILERS

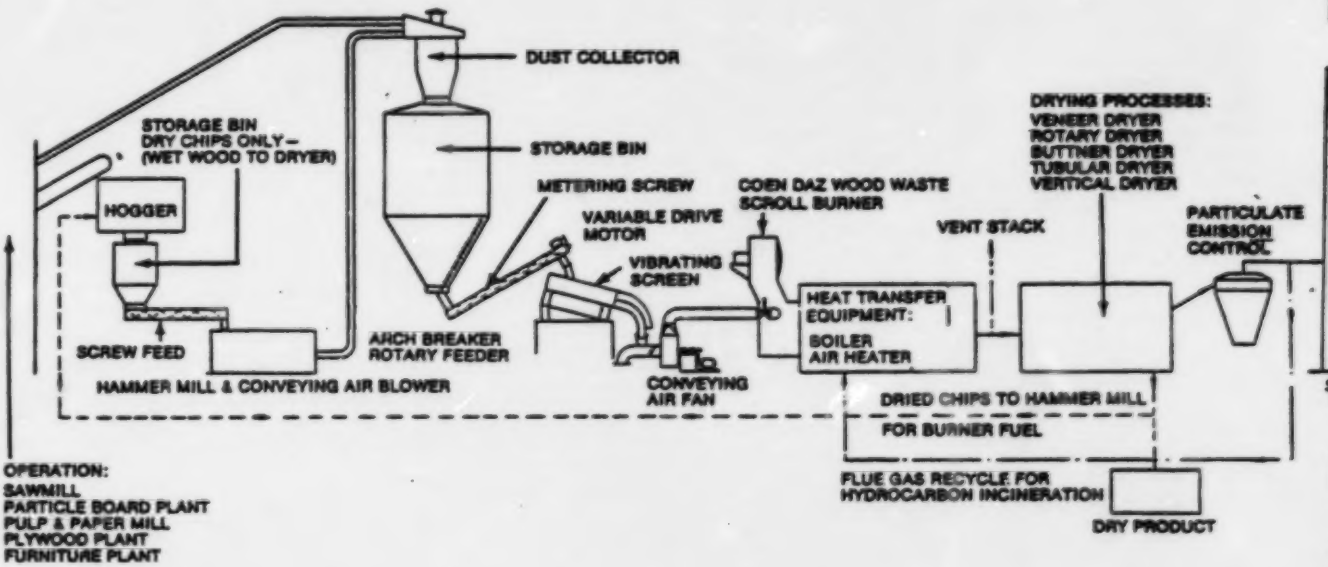
Packaged boilers are the most difficult of all boilers to fire with wood waste. The reason is that the furnaces of these boilers are cold with water walls on all sides, and that in order to ship these boilers, furnaces are necessarily very narrow. Coen has successfully fired packaged boilers with the scroll feed burner to burn wood waste in suspension in the exclusive Coen DAZ air register described on page 1. Due to the cold environment in a water wall packaged boiler, it is essential that the dry wood particle size is small enough to burn out completely during the time it takes the particle to pass through the furnace. For most packaged boilers this particle size should be no larger than 1/64" to 1/32" depending upon heat release.

The combination of a packaged boiler and a Coen Scroll Feed Burner is often the most economical way of providing additional steam to an expanding plant.



SYSTEM RESPONSIBILITY

For Size Reduction, Transport, Storage and Feed Control



Whether used on boilers, air heaters, or simply as an incinerator, the Coen Scroll Feed Burner is capable of providing the finest method of burning wood waste available. However, successful burning of wood waste involves much more than the burner. To provide satisfactory performance, the burner must be supplied with a constant flow of the required dryness and fineness and with particle size controlled. The complete wood waste handling system requires a storage bin, a fuel metering device, an air conveying system, and a screen to eliminate over size particles. In addition, a hog to reduce too large chips and a grinder (mill) to reduce to the proper fineness, a dryer when feed is wet, dust collectors and other accessory equipment may be required. If any of this equipment is improperly sized or incorrectly applied, an unsatisfactory system will result.

Coen Company has the expertise and experience to insure that system engineering is adequate. While Coen does not normally supply the adjunctive equipment in a complete wood waste system, Coen will assist in the selection of an experienced contractor in this field, or will, if desired, contract to supply complete system engineering.

Coen also has a large, experienced service department that is located nationwide. This insures swift, competent start-up of your wood waste system and satisfactory system operation.

COEN COMPANY

Combustion Engineers and Manufacturers
1510 Rollins Road, Burlingame, California 94010

FYR-COMPAK® GAS AND OIL BURNERS
FYR-PROGRAMMER® FLAME SAFEGUARD SYSTEMS
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6. Conclusions and Recommendations

The conclusions and recommendations given result from: 1) one trip to the Pinehouse area in July 81 where fire-killed trees were sampled and their moisture content estimated 2) a study of wood biomass as fuel 3) a study of modern wood burning equipment 4) a study of lime manufacture and lime kilns with the textbook by Boynton (4) as the chief reference. Commercial wood burning combustion systems and operating lime kilns have not yet been observed so the following conclusions and recommendations are tentative.

1) Wood fuel from fire-killed trees could be used successfully to calcine limestone. One ton of wood (20% moisture) is equivalent to 278 L of bunker "C" fuel for lime calcination.
2) The Lamb-Cargate multiple chamber combustor is a good device for wood fuel utilization in lime burning. Fuel preparation is inexpensive, grit on the wood and much of the ash does not enter the kiln, temperatures to 2600°F may be reached and the burner has a 5 to 1 turn down ratio.
3) A fluo-solids lime kiln appears to be the most appropriate type for the Pinehouse limestone which contains a high portion of fines and decrepitates on heating.
4) It is recommended that calcination tests be done on a ton or more of Pinehouse limestone in a fluo-solids lime kiln and or other types of lime kilns until satisfactory calcination is achieved.
5) Successful commercial operation of wood burners and lime kilns should be observed before making a purchase decision on these major equipment items.

LIST OF REFERENCES

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APPENDIX A

Moisture Content of Fire-killed Trees

Task 3 Moisture Content of Fire-Killed Trees

The general area sampled was located about 15 miles SW of Pine house Lake village. The area sampled was located on either side of the main road about a mile north of the Massinahigan River. The location on the map would 106° - 49.5' W and 55° - 23' N. Samples were taken at 13 points.

Sampling points 1, 2 and 3 were from a burn area north of the river and west of the road. We left the road about ½ mile north of the bridge, walked west through the center of the burn area and took samples as we walked back to the truck. We walked or struggled for ten minutes between sampling points. In all burn areas visited about one half of the trees were down, being weakened from decay and blown over by the wind. At each sampling point we sawed a two inch (more or less) disc at breast height from a typical tree and then cut another disc about 10 to 12 feet from the tree top. A fallen tree nearby was sampled in a similar fashion. These samples were placed in a plastic bag and identified. Samples taken during the day were weighed that same evening. Sampling points 4, 5 and 6 were on a line running west from a large gravel supply by the road north of the first location.

On the morning of July 28, we flew over the area to observe. We then cruised an area farther west and north of the gravel pile. Samples 7, 8, 9 and 10 were taken on a line through this area. After lunch we cruised an area on the east side of the road leaving the truck near the road at a point between the bridge and gravel pile. Here we obtained samples #11, 12 and 13. It started to rain about 1530 hours. We return-

ed to Pinehouse village to weigh the samples and check out.

Moisture in the wood samples was found by oven drying them at 105°C to a constant weight. The moisture content was calculated on an "as received" and dry basis. The results are given in the following table. Sample 1-S denotes the discs taken from a standing tree at location #1. The letter F denotes samples taken from fallen trees.

The average moisture content of the standing tree samples was 14% as received. The standard deviation of these results was 2.5 so that 95% of the trees would probably have a moisture content between 9% and 19%. The fallen trees were found to contain an average of 19% moisture, as received.

Sample	Field wt. g	Lab wt. g	Dry wt. g	Evap. g	% H_2O received	% H_2O dry
1S	172.0	171.5	140.7	31.3	18.2	22.2
1F	128.0	126.1	108.6	19.4	15.2	17.9
2S	198.3	196.8	176.1	22.1	11.1	12.5
2F	155.5	153.7	134.1	21.4	13.8	16.0
3S	240.0	235.5	205.8	34.2	14.3	16.6
3F	359.3	353.1	296.8	62.5	17.4	21.0
4S	1181.2	1163.8	958.9	222.3	18.8	23.2
4F	610.4	606.5	539.2	71.2	11.7	13.2
5S	1180.0	1175.8	1017.3	162.7	13.8	16.0
5F	1205.7	1191.3	856.9	348.8	28.9	40.7
6S	1687.0	1650.0	1400.5	286.5	17.0	20.5
6F	544.0	535.3	414.4	129.6	23.8	31.3
7S	366.7	367.1	321.4	45.3	12.4	14.1
7F	854.4	849.8	653.2	201.2	23.5	30.8
8S	438.8	437.5	386.2	52.6	12.0	13.6
8F	717.0	710.9	547.7	169.3	23.6	30.9
9S	569.0	566.5	493.9	75.1	13.2	15.2
9F	314.0	311.8	256.8	57.2	18.2	22.3
10S	361.8	362.1	314.2	47.6	13.2	15.1
10F	471.7	472.2	378.8	92.9	19.7	24.5
11S	196.0	195.6	174.4	21.6	11.0	12.4
11F	297.9	297.0	260.6	37.3	12.5	14.3
12S	330.0	300.6	280.0	50.0	15.2	17.9
12F	No sample					
13S	1297.3	1293.6	1102.1	195.2	15.0	17.7
13F	937.0	936.1	709.6	227.4	24.3	32.0

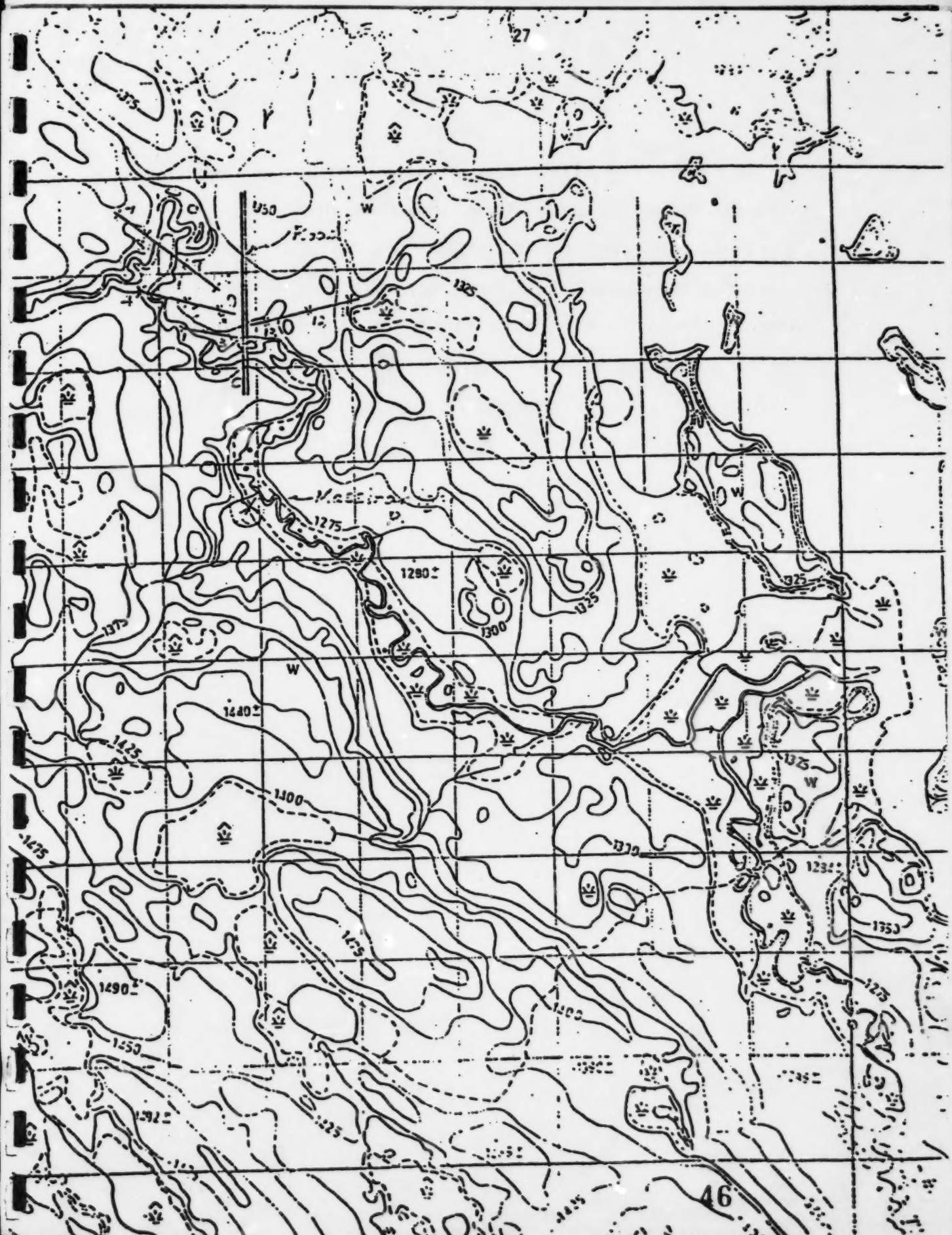
Average moisture content

Standing trees, as received 14.3% ± 5.0

16.7% ± 7.0

Fallen trees, as received 19.4% ±11.0

dry basis 24.6% ±17.0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1275
1280±
1325
1300
1375
W
1440±
1425
1400
1375
1370
1325
W
1350
1425
1490±
1450
1400
1325
1325
46

COMMENTS

The larger fire-killed trees are on drained land which was quite firm when MacPherson and I (Filson) were there in July 81. This land would support rubber tired tractors and trucks at that time. Summer harvesting is recommended, if permitted, because 50% of the fire-killed trees had fallen and many of these would not be harvested in winter. The new tree growth was about one metre in height. Much of this growth need not be trampled by summer harvesting.

The low areas were boggy and difficult to walk over. There is little fuel wood in these low areas.

APPENDIX B

References from Literature Survey

Lime Burning Using Wood Fuel

Task 1 - Literature Survey

An on line computer search of the literature on lime burning and the utilization of waste wood fuel was initiated by Fred Barnes and continued by Harry Filson. These peole are chemical engineers employed by the Saskatchewan Research Council. The results of this survey with a list of the pertinent publications received and read are:

1. Publications on Lime and Lime Burning.

   Boynton, Robert S.

   "Chemistry and Technology of Lime and Limestone", Second edition 1980. Published by John Wiley & Sons Inc., New York

   This book of 578 pages was recommended by Verne Hogg. It is an excellent book. Contents are indicated by the chapter titles.

   1) Introduction. 2) Formation and Properties of Limestone. 3) Limestone Exploration and Extraction. 4) Limestone Processing. 5) Limestone Uses. 6) Theory of Calcination. 7) Definitions and Properties of Limes. 8) Lime Manufacture. 9) Theory of Lime Hydration. 10) Methods of Hydration. 11) Uses of Lime. 12) Economic Factors Affecting Lime and Limestone. 13) Analytical Testing of Limestone and Lime.

   Clarke, G.

   "Burnt Lime in Western Europe" Industrial Minerals. No. 164 May 1981

   "This article reviews the various companies involved in the production of lime in western Europe and looks at the applications."

   "The Parallel Flow Regenerative Lime Kiln".

   This paper received by Fred Barnes from Verne Hogg. The author is

not given.

Herod, B.C.

"The Calcimatic, a New Concept in Lime Burning." Pit and Quarry, Nov. 1963. This article describes the calcimatic lime kiln built at Galloway Mo. for the Ash Grove Lime and Portland Cement Company. This is a 100 tpd unit fired by natural gas.

"Ash Grove Grows with Pacific Northwest". Pit and Quarry, June 1964. This article describes a 250 tpd lime burning plant using two calcimatic lime kilns.

Lyon, Ann - Project Engineer J.E. Baker Co. York, Pa.

"Evaluating the Burning Characteristics of Limestone & Dolomite". The article "describes a quick evaluation procedure that requires only readily available equipment".

Garrido, G.F. - Montreal, Que., Canadian Liquid Air Ltd.

Perkins, A.S. - San Francisco, Ca., Liquid Air Inc.

Ayton, J.R. - Vancouver, B.C. Canadian Liquid Air Ltd.

"Upgrading Lime Recovery with Oxygen Enrichment".

"Operating data are presented and information such as theoretical considerations, flame geometry, method of injection, and fuel type are discussed for both rotary kilns and fluidized-bed calciners". Mar. 1980

Connaghan, C.L. - Process Engineer

Kennard, G. - P & R Superintendent of Cresbrook Forest Industries Ltd.

"Oxygen Enrichment in a Calciner".

The paper describes the use of oxygen in a Dorr-Oliver fluidized bed calciner. These last two papers were presented at the 1980 Spring

Conference of the Canadian Pulp and Paper Association, Jasper, Alberta.

2. Publications on Wood Gasification.

Gurnik, G., Luke, K.D., Pollock, D.C., of ECO Research Ltd., Box 200 of ECO Research Ltd., Box 200, Station M., 2 Sheppard Ave. F., Willoddale, Ontario M2N 5S8.

"Application of a Fluidized Bed Gasifier to Conversion of Forest Biomass to an Energy Source".

Enfor Project C-68 Mar. 80

A one ton per hour fluidized bed gasifier was operated for two months. About 89% time on stream was achieved with product gas having a higher heating value of 3.7 $\frac{MJ}{m^3}$ or 100 $\frac{btu}{ft^3}$

Berry, R.I.,

"Fluidized Wood", Chemical Engineering, Sept. 21, 1981.

The University of Missouri-Rolla has a two ton per hour fluidized bed gasifier from which fuel gas of 160 btu per ft^3 H.H.V. was obtained from sawdust feed.

Feldmann, H.F., et al

of Battelle Columbus Laboratories, Columbus, Ohio.

"Conversion of Forest Residues to a Clean Gas for Fuel or Synthesis".

The article describes various catalysts for the fluidized bed gasification of wood. A discussion on economics of wood gasification is included.

Mathur, V.K., - Department of Chemical Engineering, University of New Hampshire, Durham.

Caughey, R.A. - Forest Fuels Inc., Antrim, H.H.

"Design, construction and operation of a new type of gasifier for the production of fuel gas from wood waste are discussed.

Bircher, Kieth - Manager, Process Engineering
of Omnifuel Gasification Systems Ltd., Toronto.
Performance data for the full scale Omni wood gasification system operated by Levesque Plywood Ltd., at Hearst, Ontario.

3. Wood Burning Apparatus.

B.H. Levelton & Associates Ltd., Vancouver
"An Evaluation of Wood Waste Energy Conversion Systems", Mar. 1978.
The publication was funded by the British Columbia Energy Commission. The committee "commissioned a study of the technology available for recovering energy from wood waste and an evaluation of the merits of the various systems available for energy recovery."

Fernandes, J.H. - Combustion Engineering Inc., Windsor, Connecticut.
"Wood Energy Systems State of the Art and Developing Technologies.
1976

Levi, M.P. & O'Grady, M.J. - Extension Wood Products Section, School of Forest Resources, North Carolina State University, Raleigh, N.C.
"Decision maker's Guide to Wood Fuel for Small Industrial Energy Users". Feb. 1989. Part I "provides a brief overview of the various aspects of using wood for fuel. It is designed for the reader interested in general information." Part II, which gives more detailed technical information, will be of primary interest to engineers, plant managers, and others with the responsibility for making a decision on fuel alternatives for specific facilities."

Neild, P.J., -

Suspension Systems - An Overview.

This article is from a symposium on Hardware for Energy Generation in the Forest Products Industry, Seattle, Washington, 30 Jan. 79. Various syspension type wood burners are discussed.

Fagerlund, B.,

"How Some Scandinavian Mills Get Higher Fuel Value From Bark". "An advanced technique produces dried (15% moisture) pulverized wood fiber that gives combustion with 90-91% efficiency based on actual heat value". Tappi Mar. 1980.

Crossley, F.R.E., - University of Massachusetts, Amherst, Mass.

"Wood chips - An Alternate Fuel."

The article describes some Scandinavian heating apparatus using wood fuel. Mechanical Engineering, May, 1980.

Morton, F.L. - "In-House Generation of Electricity From Wood Waste Residue".

Forest Products Journal V 26 N9, September, 1976.

4. Data Collection.

Alemdag, I.S. -

"Manual of Data Collection and Processing for the Development of Forest Biomass Relationships." Petawawa National Forestry Institute Canadian Forestry Service Information Report P1-X-4 1980.

Kirby, C.L. and Hall, R.J.,

"Description and Accuracy Evaluation of the Honeywell Radar Altimeter". Northern Forest Research Centre Canadian Forestry Service Information Report NOR-X-222, March, 1980.

Kirby, C.L. and Hall, R.J.,

"Practical Applications of Remote Sensing to Timber Inventory". Canadian Forestry Service Information Report NOR-X-224, May, 1980.

Brackebusch, A.P.

"Gain and Loss of Moisture in Large Forest Fuels". USDA Forest Service Research Paper INT-173, 1975. Intermountain Forest & Range Experiment Station, Ogden, Utah 84401.

McMillen, J.M.

"Methods of Determining the Moisture Content of Wood". USDA Forest Service, Forest Products Laboratory, Madison 5, Wisconsin.

5. General

Forest Products Laboratory List of Publications on The Chemistry of Wood. 1945-1968.

Wallis, G.W.

Research Scientist, Pacific Forest Research Centre, Victoria, B.C.

Godfrey, J.N. - Supervisor, Inventory Section, Forestry Division, MacMillan Bloedel Ltd., Nanaimo, B.C.

Richmond, H.A. - Consulting Forest Entomologist, Lofthouse Road, R.R. 2, Nanaimo, B.C.

"Losses in Fire-Killed Timber".

Howard, J.O.

"Wood for Energy in the Pacific Northwest". An Overview, USDA Forestry Service, Pacific N.W. Forestry and Range Experimental Station, Technical Report PNW-94, 1979.

Cordeo, S.E.

"Wood and Bark as Fuel"

Oregon State University School of Forestry. Research Bulletin 14, 1973.

Skolko, A.J.

Forest Pathologist, Dominion Laboratory of Forest Pathology, University of New Brunswick, Frederiction, N.B.

"Deterioration of Fire-Killed Pulpwood Stands in Eastern Canada".

Taylor, D. - Plant Superintendent, Southern Brick Co.,

"Multikiln Operation Converts to Sawdust".

Brick and Clay Record, April, 1981.

Sawdust is used as a fuel for brick manufacture.

Wiksten, N.A. and Prins, P.G.

of Arbex Forest Development Company Ltd., 444 MacLaren Street, Ottawa Ontario, K2P OM8

"Cost Estimates of Forest Biomass Delivered at the Energy Conversion Plant".

Enfor Project P-19 Mar., 1980.

Evans, R.L. and Hedley, T.B.

"Envergy from Wastes in British Columbia".

Conservation and Technology Division, B.C. Ministry of Energy, Mines and Petroleum Resources, 1177 West Hastings Street, Vancouver, B.C. V6E 2L7.

Berard, J.A.

"Recovery and Processing of Logging Residue for Energy".

Forest Engineering Research Institute of Canada, 143 Place Frontenac, Pointe Claire, Quebec H9R 4Z7.

Ellis, G.

"Cashing in the Chips", 1979.

Another article on waste wood utilization in B.C.

Berry, R.I.

"An Ancient Fuel Provides Energy for Modern Times".

Chemical Engineering, 21 Apr. 80.

PINEHOUSE LAKE LIMESTONE

PROJECT UPDATE

Prepared For

Missi Island Mines Ltd.

January, 1982

by

D.H. Bradley, P. Eng.
Ancon Research & Engineering Ltd.

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1.0 INTRODUCTION

1.1 General

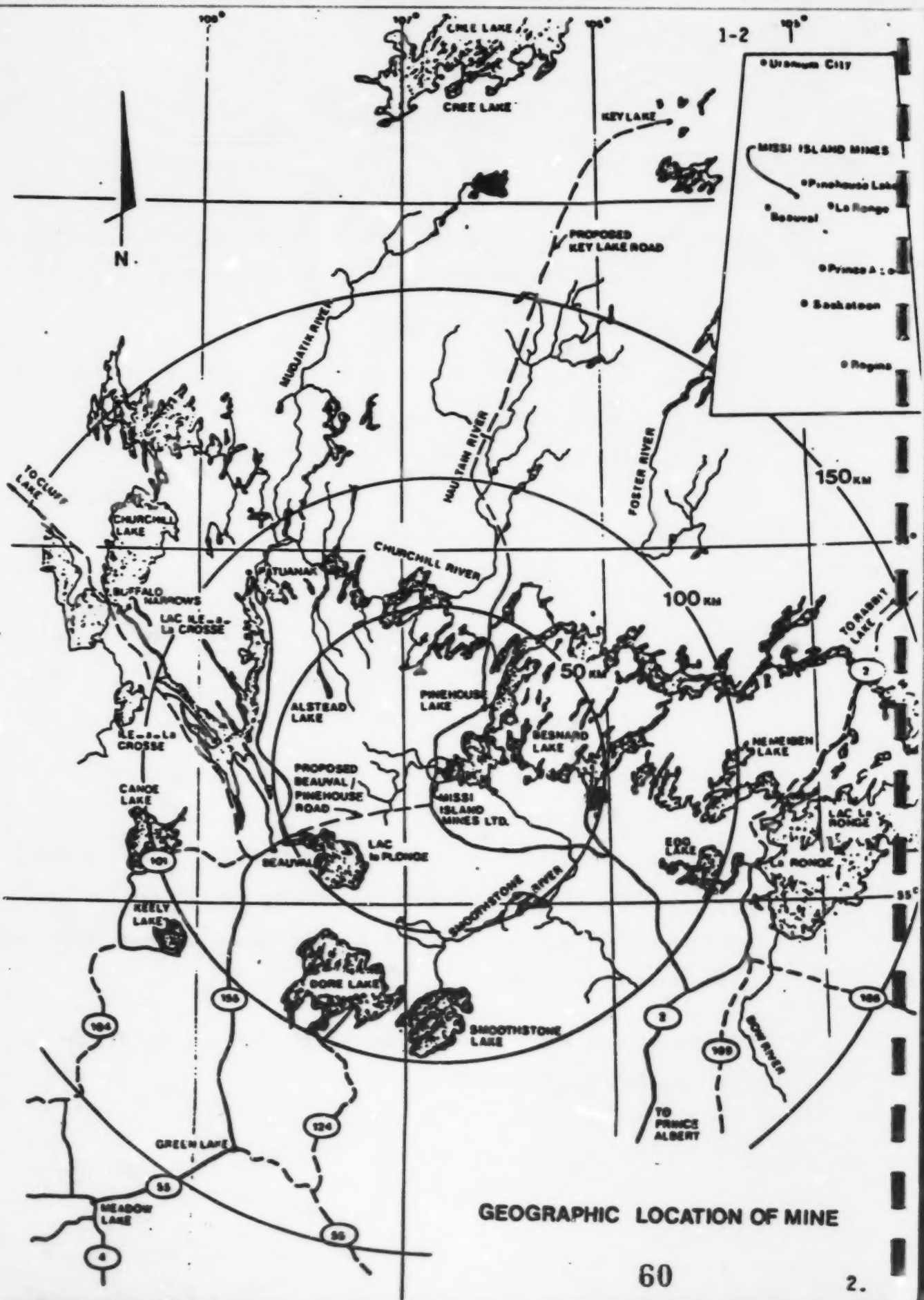
Northern Saskatchewan is currently the subject of intensive exploration for uranium mines and the development of uranium processing facilities (i.e., recently announced Key Lake Mine).

Missi Island Mines Ltd. has been actively exploring for a limestone deposit in northern Saskatchewan since 1974 with the objective of supplying the uranium industry and industrial markets in Saskatchewan with limestone and lime products. These efforts resulted in the discovery of a large, high-grade limestone deposit 35 km. south of the town of Pinehouse, Saskatchewan in 1978.

Delineation of the discovery resulted in sufficient reserve estimates to warrant preliminary feasibility studies and economic evaluations for a full-scale mine and calcinating facility.

Missi subsequently commissioned Patrick Harrison, Thyssen Mining, Trimac Transportation and Kilborn Engineering to prepare preliminary studies for mining, calcinating, and transportation facilities. These studies were submitted in 1980. Additional engineering work was carried out in 1980-81 to refine the preliminary data. The results of these studies are summarized in this report.

The report concludes that present market potential and cost factors make this this a highly feasible project.



GEOGRAPHIC LOCATION OF MINE

1.2 PINEHOUSE LAKE LIMESTONE PROSPECT OVERVIEW

LOCATION	- 150 miles south of newly announced Key Lake Lake Uranium Minesite in Northern Saskatchewan.
ACCESS	- Property located on new all-weather road connecting Key Lake Minesite to Prince Albert, Saskatchewan.
INTEREST	- Missi Island Mines Ltd. 100%
RESERVES	- 2,024,000 tonnes proven (potential unlimited)
EXPENDITURES AS OF JANUARY 1st, 1982	- $1,100,000
STATUS	- Detailed geochemistry and twenty diamond drill holes outlining extent and quality of limestone deposit. Feasibility Study prepared by Kilborn Engineering in 1980 outlining: - Reserves - Markets & transportation - Project economic sensitivity analysis - Preliminary engineering for mine and calcinating facilities - Environmental overview
LAND POSITION	- 3,520 acres covering 63 claims in lease form

1.3 PINEHOUSE LAKE LIMESTONE PROSPECT

ECONOMICS

1. Current Cost of Product F.O.B. Pinehouse $/tonne:

Limestone (pulverized)	$100/tonne
Quicklime	$146/tonne

2. Estimated capital costs for Pinehouse Mine and Quicklime Plant in 1982 dollars:

Pre-project Expenses	$2,500,000
Mine & Surface Facilities	$6,575,000
Quicklime Plant	$8,150,000

3. Estimated direct operating costs for Pinehouse Limestone and Quicklime Products:

Limestone (Crushed & Dried)	$20.50/tonne
Quicklime	$78/tonne

The Saskatchewan facility quicklime competitive cost (including a 10% premium for local product) is estimated to be $160/tonne F.O.B. Pinehouse. An estimated $82/tonne margin therefore exists for product shipped beyond this point from competitive sources. Approximately 50% of the future 60,000 tonnes per year market projected is in this category. The remainder of the market projected provides an estimated average $50/tonne margin.

For limestone a similar average margin exists throughout the market area (approximately 50,000 tonnes per year).

2.0 MARKET AREA AND PRESENT SUPPLIERS

The high costs of transporting limestone and quicklime restricts the major market area of the proposed limestone plant and calcining facility to northern Saskatchewan, northern Manitoba and northeast Alberta.

Within the geographic market area the major consumers of limestone products are the uranium industry, the pulp and paper industry, non-ferrous smelters, road construction, the chemical industry and municipal water treatment facilities. An undeveloped, but potential market in Saskatchewan, is agriculture limestone.

Steele Brothers Canada Ltd. is presently the major supplier of limestone products to the potential market area of Missi Island Mines Ltd. with mines at Faulkner, Manitoba and Kananaskis, Alberta.

There are other limestone quarries operating within reach of the defined market area. In particular these are:

- Fort Garry, Manitoba and Taber, Alberta which supply the sugar beet industry, and
- Mafeking, Manitoba which supplies a cement manufacturer

The Mafeking quarry, operated by Inland Cement Industries Ltd., is presently supplying limestone to Manitoba Forestry Resources Ltd. in The Pas.

The selling price of the various products supplied by Steele Brothers Canada Ltd. are presented in the following table. The price of quicklime has risen from $47.00 to $66.00 per tonne since 1980. This rate of escalation is expected to continue for at least two more years due to energy costs and inflation.

2.1

STEELE BROTHERS CANADA LTD.

PRODUCT SELLING PRICES

Product (Bulk F.O.B. Ekshaw)

Limestone:

Aggregate (6 mm x 50 mm)	$15.00
Pulverized (minus 20 mesh)	$20.00

Quicklime:

Crushed*(6 mm x 20 mm)	$64.50
Pulverized*(minus 20 mesh)	$66.00

* Note: From verbal communication with Bob Rose, Summit Lime.

2.2 The costs of transportation of quicklime to various locations within the geographical market area are as follows:

ESTIMATED FREIGHT RATES FOR QUICKLIME
FROM SUPPLIERS AT 33,600 Kg. G.V.W.
(In Dollars Per Tonne)

Destination	Source			
	Exshaw (2)	Faulkner (2)	Pinehouse (1)	Freight Advantage
Rabbit Lake	$111.88	-	$42.10	$69.78
Cluff Lake	107.71	-	59.97	47.74
Key Lake	106.60	-	28.88	77.72
Prince Albert (rail from Ekshaw)	29.25	-	27.60	1.65
Saskatoon (rail from Ekshaw)	27.87	-	39.83	(11.96)
Flin Flon	-	$51.33	46.90	4.43

Notes: (1) Source: Cost of a trucking operation from Missi Island Mines Ltd. by Trimac Consulting Services Ltd. 1980 escalated @ 12% per year.

(2) Source: Competitive quotations escalated @ 12% per year.

A Pinehouse Lake Quicklime Facility therefore has a $40 - $80/tonne transportation advantage to supply northern Saskatchewan uranium mines which represent the majority of existing and potential markets in the area.

3.0 LIMESTONE PRODUCT CONSUMPTION IN THE AREA

3.1 Quicklime

The major consumers of quicklime in the area are uranium mines. Quicklime is used to neutralize acid used in the extraction process to leach uranium from the raw ore.

Present consumption is approximately 22,000 tons per year, mostly for Gulf Minerals' Rabbit Lake operation. The pulp and paper industry and non-ferrous mining and smelting requirements consume an additional 30,000 tons per year, and commercial users such as the Saskatchewan Government Department of Highways and the City of Saskatoon account for a remaining 8,000 tons for a total of 60,000 tons per year.

Key Lake Mining Corporation will require an additional 30,00 tons of quicklime when their operation gets underway in 1985.

Other potential new mines in the area include Esso Resources, Asemera and Canadian Occidental Petroleum Ltd. whose combined requirements by 1987 could add another 40,000 tons to the market.

The future "insured" new added market is therefore estimated at a minimum of 30,000 tons per year by 1985 and up to an additional 30,000 tons by 1987 without incursion into existing markets.

It is anticipated that product scarcity due to the finite capacity of existing suppliers will allow for as much as a 75% incursion into existing markets by 1987 without undue competitive reaction. It is felt therefore that a Pinehouse Lake Quicklime Facility could easily obtain and hold 75% of the total market (or about 60,000 tons per year) on a competitive price basis with existing supplier. The Saskatchewan Government's policy of giving preference to local industries would tend to ensure this position.

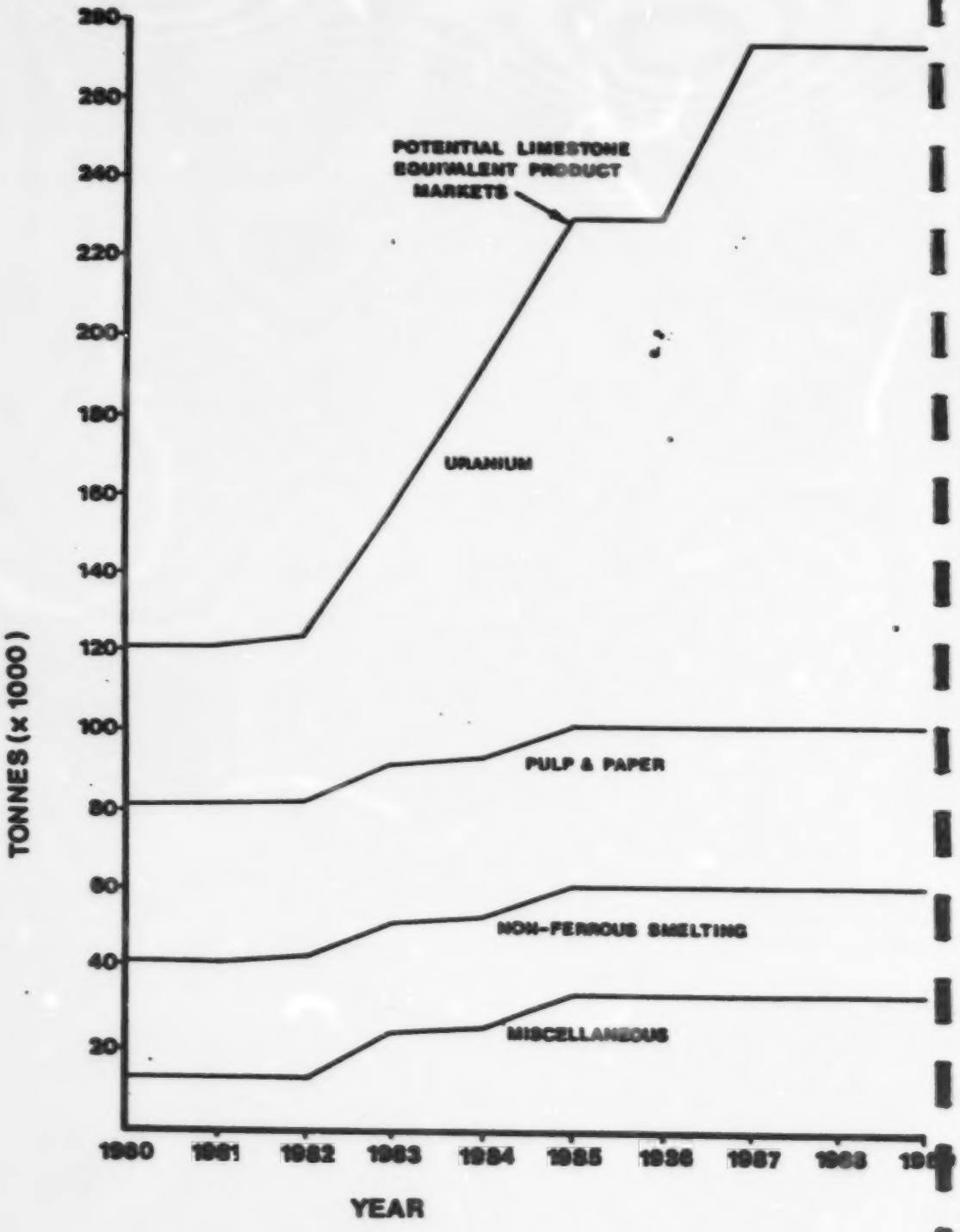
3.2 Limestone

The major industrial consumers of limestone in the market area are pulp and paper and forest industries consuming in the order of 16,000 tons per year. Agricultural limestone used to treat acidic soils accounts for approximately 5,000 tons per year and this market is expected to grow.

The potential limestone and limestone equivalent (i.e., quicklime) products market in the area has been estimated to rise to in excess of 230,000 tons per year by 1985 from the current 120,000 tons per year. As most of this growth is in the uranium mining sector, a Pinehouse Lake source could command two-thirds of the total market by 1985 without creating undue competitive reaction by other suppliers (i.e., 160,000 tons per year).

By 1987 another 40,000 tonnes of demand has been projected which an established operation would be expected to command totally.

Note: The Alberta Government initiated a transportation subsidy for agricultural lime in 1981. It is anticipated Saskatchewan will follow suit.



ESTIMATED POTENTIAL CONSUMPTION OF LIMESTONE EQUIVALENT PRODUCTS BY INDUSTRY

4.0 GEOLOGICAL DESCRIPTION, RESERVES AND PRODUCT SPECIFICATIONS

4.1 Geology

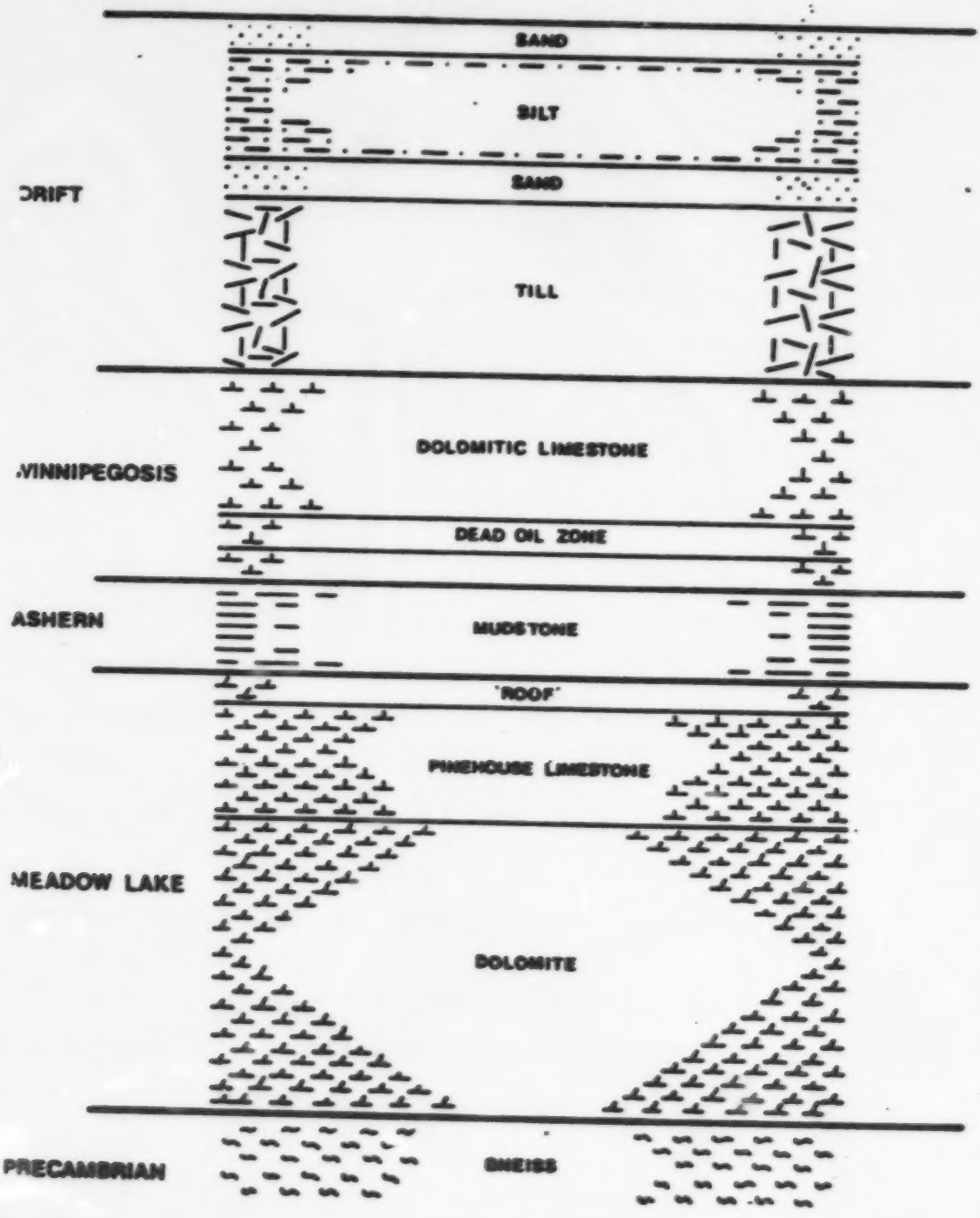
The sediments in the Pinehouse Lake area of northern Saskatchewan can be divided into five major units in ascending order:

1. Precambrian Formation
2. Meadow Lake Formation
3. Ashern Formation
4. Winnipegosis Formation
5. Glacial Drift

These major units are nearly flat lying with an overall regional dip to the southwest. Local fluctuations, caused during or after deposition, consist of local rolls and discontinuities. These are dealt with in the geological and groundwater reports prepared by Silverspoon Research & Consulting Ltd. entitled "Geology of the Pinehouse Project Area, Saskatchewan, December, 1979", and "Hydrogeology and Water Chemistry of the Pinehouse Project Area, Saskatchewan, December, 1979", and the geological intrepretation of Missi Island Mines Ltd. dated January 2nd, 1980.

The Pinehouse limestone bed occurs within the top portion of the Meadow Lake Formation. The Pinehouse limestone bed (2.2 m to 11.3 m in thickness) is predominantly fine-grained and soft with fractures and vuggs present in the core.

Hydrological discontinuities have been identified with the Winnipegosis and Pinehouse formations of the mining area. Missi Island Mines Ltd. has interpreted the hydrological discontinuities to be the result of gentle folding of the sedimentary beds which have created areas of low permeability.



STRATIGRAPHIC UNITS IN THE PINEHOUSE PROJECT AREA DH12-77 (TYP)

Isopachs of the Pinehouse limestone bed and the structural contours of the tops of the Pinehouse limestone bed, the top of the Ashern Formations and the the top of the Winnipegosis Formation have been prepared by Missi Island Mines for reserves estimates.

4.2 Limestone Reserves

The drill indicated limestone reserves have been calculated by the polygon method. It has been assumed that 65% of the limestone bed structure will be left in place as pillars and that the maximum mining height will be 3 lifts of 3 metres or a total of 9 metres. The method of calculation, using the polygon method, was as follows:

1. The drill holes were plotted in plan and section, and perpendicular bisectors of lines joining the individual holes were drawn to produce polygons. Polygons were assumed to extend 30 metres outside the area drilled.

2. A mining thickness of 6 or 9 metres was assumed based on the bed thickness determined from the geological logs. A limestone bed thickness of less than 3 metres has not been included in the reserve calculations.

3. The sum of the in-place volumes of 2,780,800 tonnes was multiplied by the measured in-place specific desnity of 2.08 tonnes per cubic metre and a mining recovery rate of 35% to give the recoverable mining reserve.

The recoverable drill indicated limestone reserve is 2,024,000 tonnes.

LIMESTONE RESERVE VOLUME

Hole No.	Area M^2	Bed Thickness M	Mining Thickness M	In Place Reserve M^3
12-77	30,528	11.2	6.0	183,200
7-78	28,764	11.3	6.0	172,600
18-79		Not in Reserve		
19-79	28,726	7.6	6.0	172,400
20-79	26,482	7.9	6.0	158,900
22-79	36,815	6.4	6.0	220,900
23-79	31,375	9.9	9.0	282,400
24-79	7,175	7.8	6.0	43,000
25-79		Not drilled to Limestone Bed		
26-79		Not drilled to Limestone Bed		
27-79		Not drilled to Limestone Bed		
28-79		Not drilled to Limestone Bed		
29-79	7,015	7.0	6.0	42,100
30-79	-	2.8	Zone less than 3m	
31-79	-	2.2	Zone less than 3m	
32-79	55,366	10.9	9.0	498,300
33-79	46,607	9.7	9.0	419,500
34-79	29,620	8.3	6.0	177,700
35-79	47,275	6.1	6.0	283,700
36-79	21,012	8.0	6.0	126,100
Estimated Total Limestone Volume				2,780,800

SUMMARY OF LIMESTONE CHARACTERISTICS FROM CORE SAMPLES

Structure

Types of Limestone	buff: perfect crystallization, firm structure white: sucrosic
Crystal Size of Limestone	50 microns
Porosity	buff - moderate white - high
Hardness (Mohs scale)	2 2.5
Compressive Strength	15 - 55 MPa
Crystal Size of Quicklime	2 - 4 microns

Analysis of Pinehouse Limestone

CaO	54.0 percent
CO_2	40.5 percent
MgO	0.37 percent
Fe (Acid Solubles)	515 ppm
Si (Acid Solubles)	144 ppm
Al (Acid Solubles)	50 ppm
S	0.02 percent
Acid Insolubles	0.59 percent
Loss on Ignition at 500°C	0.41 percent
Reactivity	Moderate High

Density

Apparent Density of Limestone	2.08 - 2.17 g/cm^3
Density of Crushed Limestone	1.01 - 1.25 g/cm^3
Apparent Density of Quicklime	1.21 g/cm^3
Density of Crushed Quicklime	0.70 g/cm^3

5.0 PROPOSED DEVELOPMENT PLAN AND ESTIMATED CAPITAL AND OPERATING COSTS

5.1 Extraction of Limestone

Independent mining studies have been carried out by Patrick Harrison, Thyssen Mining, and Kilborn Engineering. Room and pillar mining were assumed in all studies.

The development within the limestone bed will be in ore grade material and is considered as production. The major requirement will be dewatering of this zone. To date, there is no indication of absolute water quantities, however, the material has a void ratio in the order of 25%. Therefore, for each cubic metre of limestone in place, there can be an estimated 12% water content by weight. Preproduction dewatering will have to be undertaken with high capacity deep well pumps to remove all free water from the mine area.

As the depth below ground elevation to the ore body averages 40 - 50 metres over the lease area and mining tonnages are not excessive, a vertical shaft was selected for the entrance to the mine. This shaft will be bored and lined with a steel liner. Concrete grout will be pumped behind the liner to reduce water migration from strata to strata.

Initial mining proposed will consist of rooms 3 metres high by 6 metres wide, driven at the top of the deposit. After an area has been so mined a second 3 metre lift will be mined from the floor of the rooms and if additional thickness permits, a third lift ultimately will be mined.

The mining rooms will be layed out on a 30 metre grid with a designated room width of 6 metres resulting in 24 metre wide pillars. On the retreat

from a mining area, it may be desirable to increase the 35% extraction ratio by either enlarging the rooms or by mining an additional room in the centre of each pillar.

The limestone will be transported from the mining face via Load-Haul-Dump (L.H.D.) units. Production objectives for 1985 are summarized as follows:

Limestone Product	Gradation	Production (Tonnes)
Crushed Limestone	18mm x 50mm	122,000
Pebbled Limestone	6mm x 18mm	3,650
Ground Limestone	6mm maximum	45,500
Ag-lime	100 M x 10 M	2,500

Capital costs for mining and site facilities are estimated as follows in 1982 dollars:

Site Preparation	$ 100,000
Road & Access	50,000
Sanitary Systems	100,000
Water Disposal	100,000
Water Supply (Potable)	50,000
Fire Protection	25,000
Power Distribution & Standby Generators	300,000
Yard Lighting	25,000
Fuel Storage	50,000
Mine Development	2,500,000
Crushing, Screening, Stock Piling	1,200,000
Service Complex	250,000
Camp Facilities	350,000
Mobile Equipment	125,000
SUB-TOTAL	$4,725,000

Construction Indirects	$ 475,000
Engineering, Procurement, Management	250,000
Interest During Construction	250,000
Overhead	125,000
Contingency (15% of Sub-Total)	750,000
TOTAL	$ 6,575,000

5.2 Quicklime Plant

Kilborn Engineering's 1980 Report includes a process flow sheet and capital cost estimate for a 200 tonne per day calcinating facility on the mine site.

The plant proposed utilized an oil fired kiln to calcinate crushed limestone with gravity bulk silos for product storage.

Over the past year Missi has been working in conjunction with the Saskatchewan Research Council and equipment manufacturers to utilize wood as a fuel for the calcinator and for plant power generation instead of fuel oil.

As fuel costs amount to over 40% of the direct operating costs for an oil-fueled facility, substantial savings can be realized by using wood which is plentiful and provides side benefits for local employment.

The technical aspects of wood burning kilns are well known as wood is utilized in numerous facilities in the U.S. and Europe.

Revisions as a result of using a wood burning kiln as well as revisions to equipment sizes and specifications reduced the overall capital cost in 1982 dollars from the original estimate.

Capital costs for the Quicklime Plant using wood as a fuel source are estimated as follows in 1982 dollars:

Calcining Kiln and Dust Collection	$3,500,000
Wood Burner & Heat Exchangers	1,000,000
Wood Processing and Supply Facilities	500,000
Lime Crushing, Storage & Loading	1,500,000
SUB-TOTAL	$6,000,000
Construction Indirects	500,000
Engineering, Procurement, Management	300,000
Interest During Construction	300,000
Overhead	150,000
Contingency (15% of SubTotal)	900,000
TOTAL	$8,150,000

3 Direct Operating Costs

Estimated operating costs escalated to 1982 dollars from previous reports are as follows:

a) Raw Limestone (Based on 160,000 tonnes/year production)

Taken from Patrick Harrison Study and escalated to 1982 dollars

Salaries & Hages	$ 7.50/tonne
Catering	2.25/tonne
Mine Production Costs	4.25/tonne
Overhead & Administration	1.00/tonne
TOTAL OPERATING COST (Raw Limestone Product)	$15.00/tonne

b) Crushed Limestone

Raw Product Cost	$15.00/tonne
Crushing	1.50/tonne
Drying *	Nil
Storage & Loading (Bulk)	1.50/tonne
Fines Loss (15%)	2.50/tonne
TOTAL CRUSHED BULK PRODUCT	$20.50/tonne

*Note: Kiln waste heat used for drying

c) Quicklime

Crushed Limestone (1.9T/TQL)	$39.00/tonne
Salaries & Wages	6.50/tonne
Catering	2.50/tonne
Fuel and Power*	10.00/tonne
Maintenance, Overhead & Administration	6.50/tonne
Fines Loss	5.00/tonne
TOTAL OPERATING COST QUICKLIME	$69.50/tonne

*Power ($1.60/tonne) .....$ 100,000/year

Wood Fuel- 16,600 cords @ $30/cord 500,000/year

TOTAL $600,000/year

Heat required - 5,000,000 BTU/tonne product = 22,680,0 cord

Dry wood fuel heating value - 8,300 BTU/lb. = 18,000,00 cord

HHV Wood Flue gas/cord = 18,000,000 BTU (20% Moisture)

Cords/year required = $\frac{5,000,000 \times 60,000}{18,000,000}$ = 16,666 cord

6.0 PROJECT STATUS AND FUTURE WORK REQUIREMENTS

6.1 No physical work on the property was conducted in 1981 during which time work was carried out on wood burning processes and refinements to capital and operating costs. Costs reflecting current and projected market conditions summarized in this report confirm the economic viability of the project. The next phase in the development will require a $1.5 MM - $2 MM expenditure over the next 18 months to bring the project to the construction stage.

The major tasks required for this stage are:

a) Additional borehole data to determine if the limestone has subcrops. If the limestone ore body subcrops in sufficient quantity and quality, initial capital and operating costs can be substantially reduced for limestone production.

b) Additional environmental data and revisions to the Environmental Overview Statement prepared by Kilborn are required for inclusion in a formal Environmental Impact Statement for the Saskatchewan Government.

c) Detailed mining plans and cost estimates are required for the extraction of limestone.

d) Bulk tests of Pinehouse limestone are required to determine optimum equipment for calcinizing and dust collection.

e) Sample runs of Pinehouse quicklime products are required for customer acceptance tests.

f) Detailed process and facilities design and costs estimates for the calcining plant are required.

The 18 month period scheduled for these steps coincides with a 1985 plant start-up to meet the demand from uranium mines and other users and take up the slack in production from existing suppliers.

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AN ENVIRONMENTAL REVIEW OF THE UTILIZATION OF FIRE-KILLED TIMBER AS AN ENERGY SOURCE FOR A CALCINING FACILITY NEAR PINEHOUSE LAKE, SASKATCHEWAN

Prepared For:

MISSI ISLAND MINES LTD.

Prepared By:

ENVIRONMENTAL MANAGEMENT ASSOCIATES

MARCH 1982

1.0 INTRODUCTION

Missi Island Mines Ltd. is proposing to develop the Pinehouse limestone deposit by constructing a limestone mine and calcining facility. A major resource requirement will be fuel for the kiln. Burnt over forests in this general area may be technically and economically feasible as the energy source for this operation. This report provides a general environmental review of effects of utilizing fire-killed timber as the kiln energy source.

A large area of coniferous forest northeast of the proposed mine site was burned over in 1974. Approximately half of the fire-killed timber is still standing and regeneration by jack pine, poplar and birch is evident. Missi Island Mines Ltd. has stated that they would prefer to salvage this burned timber because of its superior burn characteristics. The proposed harvesting operation would be similar to other forest operations in the province with the exception that the whole tree will be utilized. The harvested fire-filled timber will be chipped and stored before burning.

2.0 ENVIRONMENTAL ASSESSMENT

A review of the available literature and consultation with Mr. Dennis Dube of the Northern Forest Research Centre, Edmonton, Alberta and Professor J.J. Balatinetz, Forestry Department, University of Toronto has enabled Environmental Management Associates to identify the following environmental impacts and concerns. In general such a project is acceptable from an environmental standpoint. The major criterion for development would be the preparation of a comprehensive management plan for the utilization of this resource.

The management plan would address a broad range of topics. Included in this range of topics would be:

1. The BTU content of the fire-killed timber and its potential to diminish over time. (If wood is heavily infested with

woodboring insects or rot the BTU content could diminish rapidly in the next 5 to 10 years.)

2. Determine the resistance of the fire-killed timber to insect attack and decay. (If the outer wood of the fire-killed timber has been naturally "case hardened" then its resistance to insect attack and decay would be very high.)

3. The procedure to be utilized in harvesting the standing timber (clear cut, strip cut or select cut).

4. The feasibility to harvest the windfall within the burned-over area.

5. Determination of the best seasonal timing for the harvesting operation.

6. The appropriate type of equipment required to to harvest the timber.

7. Methods of maximizing local benefits and local employment opportunities.

8. The potential threat to worker safety caused by the blow down of fire-killed timber.

9. Identification of waterbodies and sensitive soil and terrain units and methods available to effectively mitigate the impacts of timber harvesting on these sensitive areas.

10. Identify the methods available to maximize the reuse potential of the area (i.e., wildlife enhancement, recreation potential).

The development of a comprehensive management scheme should include the design and implementation of a thinning, or if necessary,

planting program in conjunction with the Forestry Branch of the Saskatchewan Department of Tourism and Renewable Resources. The inclusion of such a program in a properly designed fire-killed timber harvesting project could generate many positive environmental impacts.

3.0 ENVIRONMENTAL IMPACTS

A review of the concept of utilizing burnt timber as the source of kiln energy indicates a number of potential impacts. The positive environmental impacts which could result from a properly managed harvesting program are:

1. Thinning of regenerating seedlings could provide a faster growing more commercially productive stand of timber.

2. Removal of hardwoods (poplar) and shrubs could increase the productivity of future conifer growth.

3. The removal of the fire-killed timber from the area will reduce the fire hazard which usually peaks 15 to 20 years after a fire.

4. The harvesting of the whole fire-killed tree for chipping avoids the traditional forestry problems of slash and debris disposal.

5. Harvesting portions of a large area of burned over forest could increase the carrying capacity of the area for wildlife by shifting the course of plant succession back to an earlier, more productive seral stage and by creating a mosaic of different stages of plant succession.

6. Harvesting of this timber utilizes a resource which has little alternate potential for use. Burned timber is commonly

of little use for saw logs as it is readily attacked by wood-boring insects.

7. Weetman and Webber (1971, 1972) state that it is unlikely that whole tree logging will lead to any reduction of tree growth in the second rotation as a result of a loss of nutrients.

8. There can be significant economic benefits to this region of Saskatchewan by utilizing local resources and manpower.

Some negative environmental impacts which could arise from this project are:

1. Inappropriate harvesting procedures may destroy such numbers of tree seedlings that forest regeneration could be inhibited.

2. Unplanned harvesting and associated road construction could result in serious erosion and siltation problems which could cause a deterioration of the water quality in the local watershed. These erosion and siltation concerns are common to any forestry operation in the northern boreal forest.

4.0 CONCLUSION

Reviewing these preliminary impacts indicates that a properly designed management plan can reduce or eliminate the potential negative impact, leaving the project with mainly positive impacts. The job creation potential is a significant positive social impact. At the present time this resource appears to have few alternative uses and therefore the net local and regional economic benefits could be substantial. We would recommend that from environmental and community viewpoint the harvesting of fire-killed timber should be reviewed in depth. In general there appears to be no environmental parameters that an effective management plan cannot

reduce to an acceptable level. It can be expected that during detailed forestry invegestigations small areas will be eliminated from the harvesting potential because of a unique or sensitive situation. The overall environmental concerns for this total project are more related to the site-specific mine mill complex than to the harvesting of the burnt timber.

5.0 REFERENCES

Weetman, G.F. and B. Webber. 1971. The influence of wood harvesting on the nutrient status of two spruce stands. Pulp and Paper Research Institute of Canada, Woodlands Rept. WR-33. 26 pp.

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